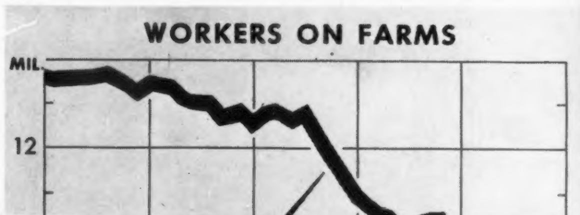
JULY 1957

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers



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Agricultural Engineering

Established 1920

CONTENTS • JULY, 1957 • Vol. 38, No. 7

Note: AGRICULTURAL ENGINEERING is regularly indexed by Engineering Index and by Agricultural Index. Volumes of AGRICULTURAL ENGINEERING, in microfilm form, are available (beginning with Vol. 32, 1951), and inquiries concerning purchase should be directed to University Microfilms, 313 North First Street, Ann Arbor, Michigan.

AGRICULTURAL ENGINEERING is owned and published monthly by the American Society of Agricultural Engineers. Editorial, subscription and advertising departments are at the central office of the Society, 420 Main St., St. Joseph, Mich. (Telephone: YUkon 3-2700).

JAMES BASSELMAN, *Editor and Publisher*

SUBSCRIPTION PRICE: $5.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to ASAE members anywhere, $3.00 a year. Single copies (current), 50 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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TITLE: The title AGRICULTURAL ENGINEERING is registered in the United States Patent Office.

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Engineering Enrollment Up . . .

MORE students are preparing for engineering careers this year than at any time since 1948, according to a recent report from the American Society for Engineering Education. Figures compiled by the U.S. Office of Education (U.S. Department of Health, Education, and Welfare) and ASEE show a total of nearly 243,000 studying in accredited engineering colleges in the fall of 1956.

This total is almost equal to the all-time high of 1947, when the colleges were jammed with World War II veterans. And today's trend is said to be still upward. These increasing numbers, says Dr. W. L. Everitt, dean of the college of engineering at the University of Illinois and president of ASEE, emphasize the "overwhelming problem" of engineering colleges: a shortage of qualified teachers to meet predicted needs.

Industry seeking more engineering graduates than it finds in college placement offices may take heart in this year's figures. The enrollment of senior (fourth-year) students in engineering in the fall of 1956 was up 20 percent over 1955, when graduates numbered nearly 24,000. Engineering students this past year amount to 12.5 percent of the total of men attending colleges, compared with 12.1 percent a year ago. The figures used in the report cover all institutions in which one or more engineering curricula are accredited by the Engineers Council for Professional Development, the nationally-recognized professional accrediting group.

Graduate studies in engineering also show a rapid gain in popularity, though the numbers involved are still small. The total of 22,240 M.S. degree students is 20.8 percent more than the number last year, the largest increase reported in any category in this year's survey. About 3400 students are working toward doctor's degrees in engineering this year — up 7.6 percent. Engineers graduating with B.S. degrees during 1955-56 totalled 23,547, compared with 20,200 in the previous year. In 1949-50, when the peak of World War II veterans were finishing their college careers, 48,160 engineers were graduated. But the numbers declined rapidly after that, and especially since the Korean War the nation has been feeling an increasing pinch in the supply of competent talent. The full report on 1956-57 enrollments is published in the March, 1957, number of the Journal of Engineering Education, official ASEE monthly.

Code of Recruiting Ethics . . .

CONCERNED that the great demand for engineering graduates will lead to excesses in college recruiting, the American Society for Engineering Education and the Midwest College Placement Association have joined to prepare a new "code of ethics" on Recruiting Practices and Procedures. The code says — in effect — that industry, colleges, and students must especially seek to be prompt, businesslike, and honest in their placement activities because of the temptations of today's keen demands for graduates.

Employers should avoid "elaborate entertainment and overselling." There should be no "special payments, gifts, bonuses, or other inducements," nor should there be reward for a third party who may prevail upon a student to accept an employment offer. On their side, students "should not hoard or collect job offers." When a student accepts an offer he should let other prospective employers know his decision and he should not accept additional interviews. Students invited to visit plants or company headquarters should decline unless "sincerely interested" in working for the company, and their expense sheets for such trips should include only expenses directly concerned.

Copies of the new "code of ethics," Recruiting Policies and Procedures, are available from the Secretary of ASEE, University of Illinois, Urbana. Single copies are priced at 25 cents each. Discounts are given for quantity purchases.

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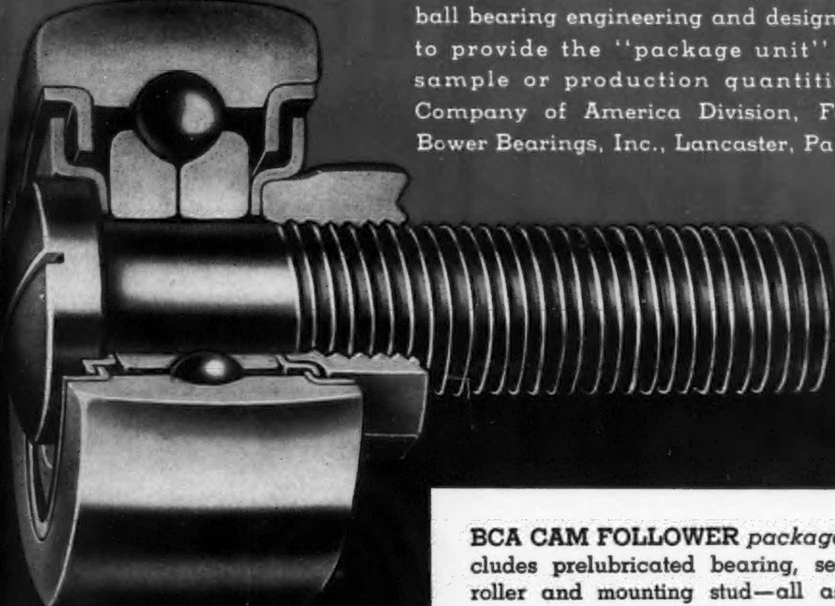

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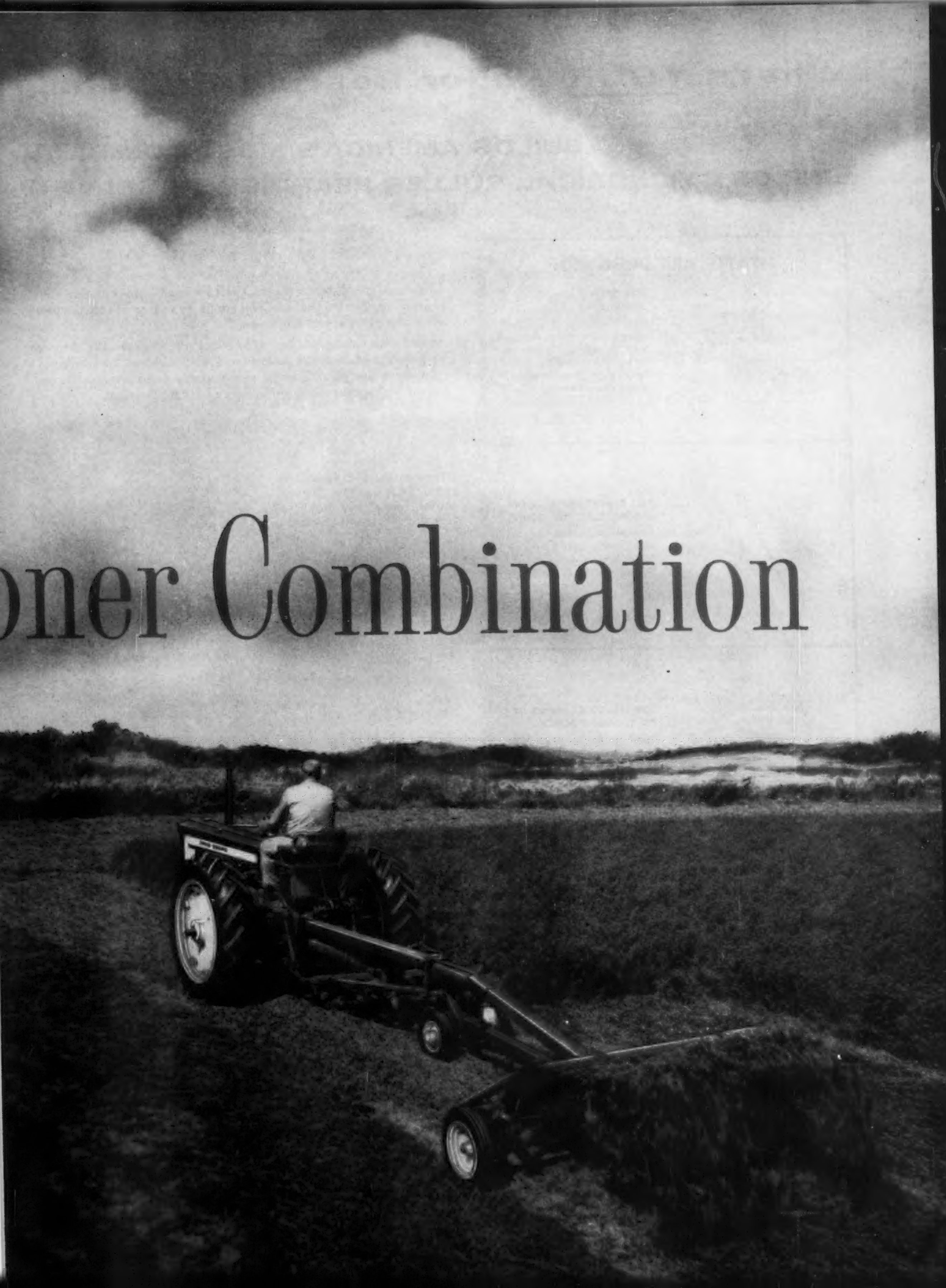
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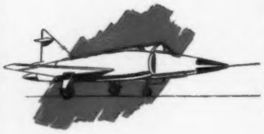

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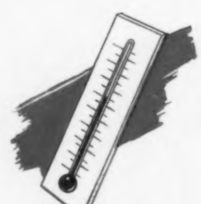

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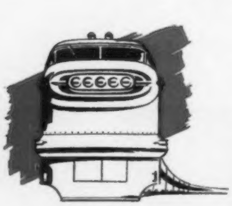

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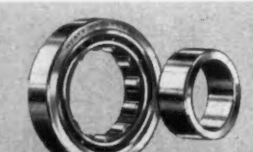

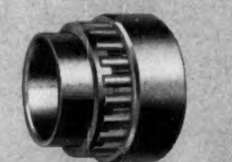

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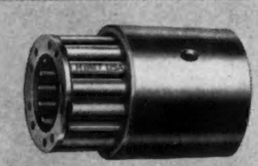

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Report to Readers . . .

SIMULATED HURRICANES TEST FARM BUILDING DESIGNS

Ag engineers at Virginia Polytechnic Institute can now order a hurricane any time of day to help them test stresses and strains on farm buildings. H T Hurst and J P H Mason, Jr., have developed special equipment that will make it possible to simulate, within the space of a few days, the effects of many years of wind and snow loads on farm buildings. The equipment consists of two hydraulic loading systems, a holding frame, and several automatic recording instruments. . . . When the engineer designs a building, he tends to overdesign. However, in spite of large factors of safety in some parts, severe weakness may show up in others, especially in joints. The idea of these VPI engineers is to make it possible to chart the life expectancy of present building designs, as well as to help design future buildings which are safer, more durable, lower in cost - and sufficiently versatile to facilitate such modification as may be required from time to time by changing farm practices.

CHEMICAL AND BIOLOGICAL CONTROL OF INSECT PESTS

A recent AP dispatch reports one chemical industry executive as saying his company is withdrawing from the insecticide business, because wide-scale use of insecticides is upsetting the balance of predator-parasite insects, which "could easily cause heretofore unimportant insects to increase to the status of economic pests." This appears to be the first company to take such a step, but it is understood others are considering similar action. . . . This executive thinks insecticide companies and government should encourage research on the selective control of insects. . . . The May-June IHC "News About Farming" reports that biological control of orchard insects, rather than sole dependence on chemical means, is being attempted by a Canadian government entomologist. His program is to build up natural parasites and predators. His results since 1948 show progressive declines in coddling moth population, also one-third reduction in spray costs in the case of bud moths and red mites. . . . Looks like an urgent need here for combined entomologist-engineer teams to undertake some realistic research studies on the selective control of insect pests. Availability of private and public funds is the first ingredient needed to set the stage for the researchers to get on the ball.

HAY-IN-A-DAY HAYMAKING LESSENS WEATHER RISK

Farmers, agricultural engineers, equipment manufacturers and others have long sought ways and means of circumventing weather risk in haymaking. On the whole, it seems to us, progress toward a solution has been relatively slow. . . More recently, however, there has been more evidence that equipment builders are closer to licking the problem. Latest system to catch our eye is what the manufacturer (New Holland) calls "hay-in-a-day". . . . It works this way: A mower-crusher performs the first operation. (With the crushing rolls, field-curing time is cut in half.) When moisture content is down to 50 percent, the hay is raked into light, fluffy windrows. At about 40 percent moisture, the hay is baled and the bales loaded on trailing crop-drying wagons. One or more of these loaded wagons, depending on drier capacity, are then placed side by side, hooked to a portable drier, and dried during the night hours, ready for storage next morning. . . . This system represents a long stride in the direction of insuring more consistent production of top-quality hay.

"TECHNOLOGICAL EXPLOSION ON THE FARMS OF AMERICA" That is actually what is occurring, to use the words of Secretary of Agriculture Ezra Taft Benson in a recent speech. "Since 1940, production per worker has nearly doubled," he stated, and "these changes make it virtually impossible to curtail agricultural output with the type of controls acceptable in our society." What engineers, ag technologists, and equipment manufacturers have contributed toward setting off this "explosion" is of course commendable; it has been in response to a great national basic need. And this need - greater, and more efficient, more economical production - continues and will continue to exist. . . . The immediate urgency, however, is for compensatory adjustments in the general economy that will tend to iron out the initial disruptive effects of the "technological explosion." Present trends in the farm production picture do indeed appear to be headed in the direction of national crisis. The situation calls for generous give-and-take on the part of just about everyone.

RURAL CUSTOM OPERATORS APPEAR IN NEW GUISES Nostalgic memories of those of us who grew up in rural America in the horse-and-buggy days are almost certain to include seasonal visits of the traditional custom threshing rig, of which only the memory lingers on. . . . But the custom operator has by no means disappeared from the rural scene. He still survives and prospers in new guises. The most recent example to come to this scribe's attention is the fleet of portable feed mills operated by the Ralston-Purina dealer organization. Each week, for example, one of these units, powered by an internal-combustion engine, pulls onto a Tennessee farm to grind feed for 400 dairy and beef cattle. . . . With the increasing rate of investment in equipment farmers are required to make, to keep pace with the rapid trend toward mechanization, opportunities for rural custom operators to fill a variety of farm custom power needs should be correspondingly greater. . . . Well, may their breed multiply and replenish mounting rural power needs.

HOG-RAISING SYSTEM INCLUDES ENVIRONMENTAL CONTROL Following principles of management suggested by Dr Damon Catron of Iowa State College, the story of how an Iowa farmer (Max Bailey) developed a unique new system of raising hogs, with particular reference to special housing and equipment required by the management and nutritional phases, is told by S S DeForest in the May "Successful Farming." The buildings and equipment, which called for a heavy investment, were given first consideration by Mr Bailey in planning his hog-raising operation, which is intended to reach eventually a production of 2,000 hogs per year. . . . Author DeForest, who rates Bailey's setup as being quite outstanding, concludes: "This management system, plus buildings and equipment, may well be the forerunner of complete environmental control for hogs."

METAL TERMITE SHIELDS PROVEN TO HAVE FAILED A contemporary of ours, "Wood Preserving News," some time back published a piece with the crisp heading: "Termite Shields Have Failed." The article reports that recently chief architects of 14 out of 15 FHA district offices have declared termite shields to be ineffective. Even the inventor of the shield 30 years ago has repudiated them. Briefly stated, it has been found that a colony of termites can readily build an earthen shelter tube up over a metal termite shield. . . . Of course "WPN" has the answer for a substitute termite discourager, namely, pressure-treated lumber!

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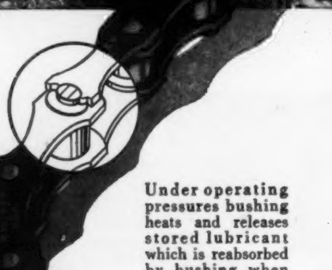

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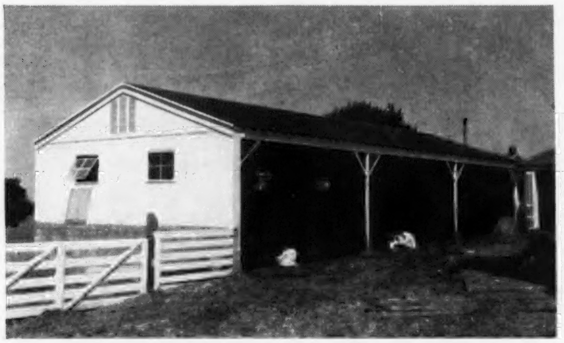
This building does double duty as a farm shop and a machinery storage building. Erected on the farm of Lester Denton, Galloway, Ohio.



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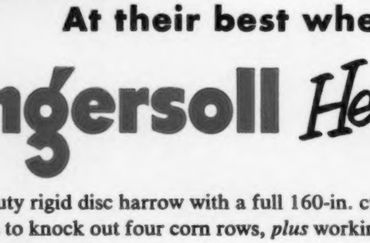
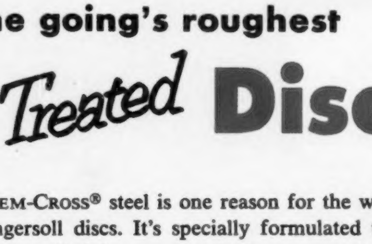


Kewanee Model 10 turning a cover crop with extra tough Ingersoll discs.



Leveling a bean field, Kewanee Model 8 does the job with Ingersoll discs.

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Agricultural Engineering

July, 1957
Volume 38
Number 7

James Basselman, *Editor*

The Golden Anniversary of Agricultural Engineering

FIFTY years ago a small group of imaginative men organized the American Society of Agricultural Engineers. They were dedicated to the application of engineering principles to agricultural production. The success of this venture is manifest throughout the country today. The nation and particularly those in the profession owe a great debt of gratitude to these enterprising individuals who foresaw an industrialized agriculture. Their contributions as well as those to follow were great.

The leadership of this nation in the world today is due primarily to the development of a strong mechanized agricultural industry —an industry that produces food and fiber in abundance with less than 13 percent of the nation's working force on the production line. The millions that have been released from producing the necessities of life are now employed in other industries and professions — industries and professions contributing to America's remarkable industrial expansion and the high standard of living that now prevails in this country.

The industrial revolution in agriculture started in the 19th century following the invention of such machines as the cotton gin, reaper, steel plow, binder, combined-harvester, etc. However, this movement was given its great impetus with the founding of the American Society of Agricultural Engineers early in the 20th century. Following the founding of the Society came organized research directed toward mechanizing agriculture. The amount of research increased gradually as the profession grew — until today, when several thousand workers are devoted to research and development, strides are being made beyond the fondest dreams of the founders themselves. Only recently, Bottom and Dunbar* pointed out that production per farm worker has practically doubled in the past fifteen years (one worker in agriculture now produces the food for nineteen others). On a percentage basis, the gain was equivalent to the advances achieved in the past 120 years. With almost 5 million tractors and 95 percent of the farms electrified, the American farmer should lead the world in production for many years to come.

The American Society of Agricultural Engineers has enjoyed a steady growth since its inception. The membership today approaches 5,000. For more than 35 years, Raymond Olney served as Secretary and Treasurer of the Society, and Publisher and Editor of the Journal, thereby directing the destinies of the organization through the formative years. No other individual has contributed more to the present development and success of the Society than Mr. Olney. His wisdom and judgment were felt throughout the many years of his service. Fortunately, he has continued as counselor during the reorganization of the headquarters staff. The office continues in capable hands, with Jimmy L. Butt as Secretary. The office of Treasurer was added to the duties of Assistant Secretary Ralph A. Palmer, and James A. Basselman is doing an excellent job as Publisher and Editor of the Journal and Yearbook. It has been a pleasure for your President to work with this group during the past year. The future of the organization continues to look bright with these hard-working men in office.

ROY BAINER
President of ASAE, 1956-57

With the January 1957 issue the Journal was restyled and showed the result of a general face-lifting. The Society owes thanks to Past-President Wayne Worthington for making arrangements with the well-known stylist and designer and member of this Society, Henry Dreyfuss, for his assistance and suggestions.

During the past year, provisions were made to carry abstracts of papers presented at various meetings of the Society. In cases where the paper is not published in the Journal, mimeographed copies are made available to meet a limited demand.

At the request of the Editor of the Journal, review committees are being appointed from the different sections to assist in selecting the very best papers for publication. A serious problem confronting the organization is the limited space available in the Journal for the publication of the ever-increasing agricultural engineering literature. Because the Journal is self-supporting, the space available for research papers is related to the space sold to advertisers. During 1956, the total pages devoted to technical papers amounted to approximately 240, which took care of about 72 papers. This is only a small fraction of the papers presented each year at the combined meetings of the organization. The program for the East Lansing meeting alone lists 60 papers.

A logical solution to the Journal space problem would be to revive the Transactions once published by the Society. It would probably be necessary to make a separate charge for them. This extra publication space would permit carrying a few more articles of a popular type in the Journal. Another possibility would be to limit the number of pages per author, making a page charge beyond two or three. In any event, the articles in many cases should be limited to some reasonable length. The review committees will be in a position to make suggestions to authors regarding the length and make-up of their published papers. As the number of readers increases, additional advertising can be sold, which in turn will provide more space for technical papers.

The future of the Society rests in the strength of her sections. The highlight of your President's year was his participation in sectional meetings. He regrets that he was not able to attend more regional meetings. Probably not more than 20 percent of the membership is fortunate enough to attend either the annual or winter meetings. Consequently, the majority of the members are acquainted with the Society only through its publications and sectional activities. The exchange of ideas, good fellowship, student participation, and technical programs developed at the section level are strengthening factors in the Society as a whole. The recruitment of new members is practically a sectional activity. This is primarily because participation in a local program offers new members something tangible. The formation of new sections in strategic locations should be encouraged.

The opportunity for student participation at sectional meetings far exceeds that at the national level. Graduating classes in agricultural engineering constitute the best res-

(Continued on page 544)

Annual address of the president of the American Society of Agricultural Engineers before the Golden Anniversary Annual Meeting of the Society at East Lansing, Mich., June, 1957.

*Bottom, J. Carroll and Dunbar, J. O. The business and agricultural outlook and Technological developments. Farm Equipment Institute Economic Newsletter, 1957.

Tomorrow's Agricultural Engineers—Their Opportunities

Harold E. Pinches
Fellow ASAE

AGRICULTURAL engineering as a profession, now 50 years old, surely is mature. Nevertheless, it is worth looking at some of the facets or aspects of agricultural engineering through which there may be developed more maturity and greater dignity—the dignity that springs from inner self-confidence and from outward recognition of superior ability and service.

Superior ability and service will stem from adequate preparation to handle problems associated with the growing necessity in agriculture of increased labor efficiency, more advanced and more complete controls of environment in the production of food and fiber, and more direct association of agricultural output with the requirements of many and varied markets. In other words, it is incumbent upon us to prepare ourselves, and to lead students in their preparation, for the problems of tomorrow, and, thereby, become "tomorrow's agricultural engineers."

It may be said in general that the opportunity, indeed the responsibility, is for agricultural engineers to work on only the most important things. It will be necessary for at least several years to be economical in our uses of engineering talent and resources. This means that agricultural engineers should be led in their work by imagination and perception of the future—whether that work is research, teaching, or practical and immediate farm or industrial applications.

For emphasis, it might almost be said: Don't work on the familiar pattern, since that is passing. The older organization of agriculture, based on abundant supplies of cheap labor and exploitation of new land, provided little incentive to investment of capital in equipment or processes to save labor or to produce a better or a new product. That is the pattern which is passing very rapidly. The problem of farm machinery, consequently, is no longer the implementation of the art of husbandry and of rural traditions, but rather the development of the necessary mechanical complements to advances in agronomy, soil science, soil and water conservation, and labor conservation.

Similarly, buildings must be conceived as no longer designed just as "shelter" for the farmer, or to provide for the animal an approximation of the farmer's ideas as to what constitutes animal comfort. We are beginning to learn through psychroenergetic, cardiac, and metabolic measurements what animals really require. We need to follow from such basic information through to the design of structures suited to the fundamental requirements of farm animals.

Paper presented at meeting of the Southwest Section of the American Society of Agricultural Engineers, Birmingham, Ala., February 5, 1957.

The author—HAROLD E. PINCHES—is Assistant to Administrator, Production Research, (ARS), USDA, Washington, D. C.

We are beginning to realize, also, that farm structures are more than large-scale boxes to keep out wind, rain, and cold. They should be regarded as parts of an integrated complex of structures, mechanisms, and applications of energy for the accomplishment of economic processes. Hence, much more is involved than characteristics of materials, design of roof trusses, etc. These strictly structural questions come last, after the functional requirements of the structures are determined.

New Agricultural Era

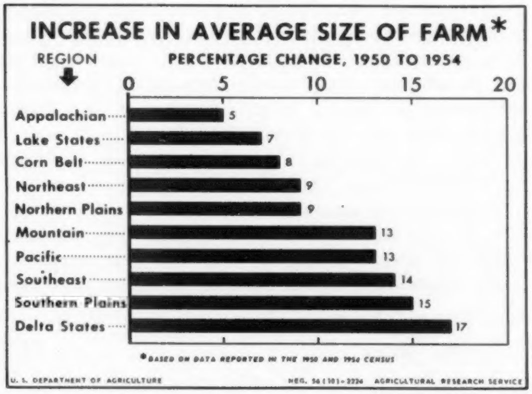
The use of engineering talent in research and the development of curricula and teaching aims may both be influenced by consideration of the probable characteristics of farms and farming in the future. For the characteristics of future agriculture, let us look to the economists, the agronomists and soil scientists, and the animal scientists. They, individually by disciplines and severally, can indicate much of what the problems for tomorrow's agricultural engineers are going to be.

Agricultural economists are pointing toward fewer and larger farms. One of the important and hopeful aspects of modern agricultural machinery is that it may be the key to sufficient enlargement of farms in some areas to form economic units. The trend toward fewer but larger farms has been going on for many years, but this process has become even more important in the last few years. In 1956, one-third of all farm land transfers was for the purpose of enlargement of farms. The economists conclude that the trend toward farm enlargement can be expected to continue. These larger farms of the future undoubtedly will use more power and less labor per unit of output.

Since there is unlikely to be any easy return of higher profits from farm production through higher prices, the answer must be as it is in all industries, viz., through lower costs, substitution of capital and power for costly labor, simplification of processes, elimination of unnecessary operations, and increasing control over processes and products to reduce losses. Obviously, all of these steps will involve opportunities for and require applications of increasingly good engineering.

Now, look to the agronomists and soil scientists for what their developments foreshadow about future agriculture. They are introducing new crops, some of which are heavier-producing strains of crops already being grown in this country, and some being introductions of new crops. Many of the new crops have machinery problems. Many of them may depend upon development of new or modified machines to make them into economic crops.

In soil management, better tillage, and better fertilizers applied in greater quantities and more accurately can be foreseen. With the machines, power, and knowledge



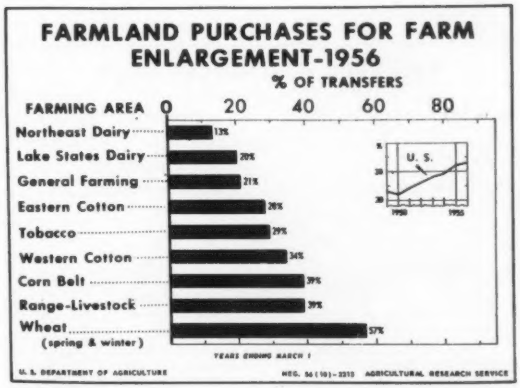


Fig. 1 *(Left)* Graph shows increase in average size farm. • Fig. 2 *(Right)* Graph shows farmland purchases for farm enlargement — 1956. From these data it can be expected that the important trend toward fewer but larger farms will continue

available, fields and farms can and will be remade in many areas for more efficient operations. We are entering what may be identified as the third wave of subduing the land for agricultural purposes. The first wave involved primary clearing and a limited amount of surface drainage. The second wave involved finishing the clearing, a certain amount of reshaping the surface for productive purposes as by terracing, and more extensive drainage. In the third wave, using powerful machinery, the microtopography of more and more fields will be changed, as in land forming, development of parallel terraces and bench terraces, subsoiling, and perhaps much more under-drainage.

Turning to the animal scientists for their contribution to tomorrow's agriculture, it is possible to see substantial changes in the agriculture of some regions coming through the development of breeds and strains of livestock better adapted to the climatic requirements or other hazards of the region. While it will no doubt be true for the entire nation, structures will attain a new position of importance on farms in the South. We are beginning to understand that for most varieties of livestock, structures are needed as much or more for modifying summer conditions as has been thought necessary for northern winters. While nearly all parts of the country have summer periods of extreme stress for livestock, the concept of summer environmental conditioning has special significance for the South.

Problems to Solve

In this changing agriculture, many technical problems will arise which cannot now be foreseen in detail. However, the probable area and general nature of some problems may be forecast with some confidence.

One problem will certainly be to design machinery and develop methods to keep up with changing concepts as to how soils should be handled. This is, indeed, a whole family of problems involving at least the following: *(a)* reduction of soil compaction; *(b)* while establishing a seedbed, creation of a rough, loose surface condition to resist erosion by water or wind, enhance insoak of water, and cut down on weeds; *(c)* preparation of seeding strips, i.e., seedbed strips, at time of planting, rather than overworking the whole field prior to planting; *(d)* integration of tillage-chemical controls over weeds and other unwanted growth; *(e)* remaking of the microtopography of farm fields to eliminate small fields, improve drainage and erosion control, and increase efficiency of operations.

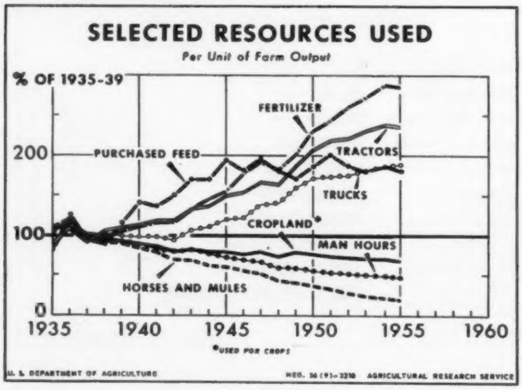
Another group of problems will lie in the mechanization of more phases of more crops. This will appear in many forms. Sometimes the problem may be related to a new crop and be concerned with the development of mechanical principles and methods for planting, culture, or harvesting of the new crop, to make possible the expansion of acreage or reduction of costs necessary to make the new crop into an economic crop. It may be a problem of partial or full mechanization of an existing crop. Here, the easy answers are in. The tough ones are ahead, such as fruit picking, tobacco harvesting, and harvesting of most vegetables.

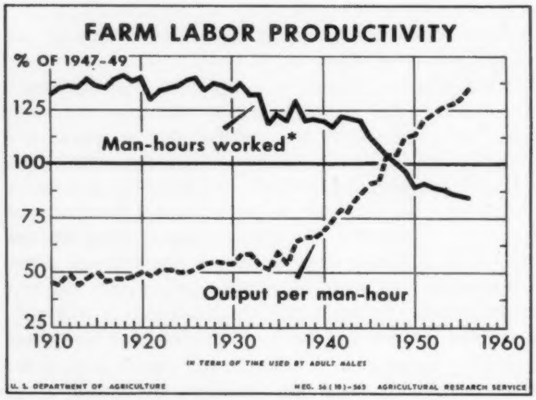
Another large area of research, just opening up, is the integration of harvesting, field handling, and certain of the first steps to market, e.g., sorting, packaging, and conditioning for shipment, as means of reducing costs and getting a better product to consumers.

Power and Energy Opportunities

Tomorrow's agricultural engineers will be called upon for development of many new methods and devices for application of power and energy to farm operations and processes. Indeed, it is worth considering whether we may not be at the beginning of a new phase of farm mechanization. Much of the present mechanization evolved through the phase of substituting mechanical power for animal power, while having to learn at the same time how to make mechanically efficient and dependable tractors and power implements. As agricultural engineers, we should consider whether most of our attention and resources have not been spent on problems which were essentially *mechanical* engineering in nature, and whether, consequently, we have failed to see the possibilities in *agricultural* applications of power and energy with sufficient imagination and perception.

This does not mean that work leading to improvements in engines, utilization of fuel, transmission of power, and so on were or are undesirable. That type of work must go on, of course, but it is essentially mechanical engineering applied to agricultural machines. It is desired to suggest here, in addition, and as peculiarly the function of agricultural engineering, that horizons be broadened and sights be raised on radically different methods and processes possible through adaptation of the large variety of types and sizes of





Capital and power are being substituted for labor. Fig. 3 *(Top)* Graph shows selected resources used • Fig. 4 *(Bottom)* Graph shows farm labor productivity.

power sources now available. We are no longer limited to hitching an implement to a tractor or mounting it on a tractor — assuming, at the same time, that generally the farmer will have only one tractor and all power tools that he will use must be integrated with it and assuming, also, that a high load-factor should be obtained for a large percentage of the operating time of this one power unit. The following examples may illustrate: *(a)* The efficiency of a chain saw is probably very low in terms of horsepower-hours per gallon of fuel, but this device is a challenging and highly-useful application of power through which the productivity of the operator is increased so greatly that questions of efficiency of mechanisms are nearly academic. *(b)* A self-propelled hay baler has recently been introduced for use on smaller farms. This baler uses two engines, one to propel the baler and the other to operate the baling mechanism. Thus, through use of two comparatively light-duty engines and greatly simplified power transmission, the advantages of self-propulsion are made available in a limited-duty baler where otherwise the more cumbersome, less flexible pull-type PTO-driven baler would be used. *(c)* The mounting of large capacity electric generators on tractors opens new vistas of approach in flexibility and versatility of power application to operations and processes which have not yet been adequately mechanized.

These three examples, chosen for illustrative purposes only, point in some of the directions in which progress is to be expected, in addition to the trend toward larger tractors, which puts greater energy capacities in the hands of operators and permits larger output per man-hour or machine-hour of operation. But agricultural engineers should not be thinking of these larger tractors only to pull bigger implements. Since the tractor is and will doubtless continue as the primary source of mobile power for farmers, there should be extensive investigations, conducted with enthusiasm and wide-ranging imagination, of transmitting power in versatile forms such as electricity or hydraulic power.

Electrical Energy Demands

Central station electricity is available to nearly all the farms in this country. That does not mean, however, that the job of rural electrification is finished. There are substantial grounds for saying that we have only just begun adapting farm activities and processes to the use of electric energy.

As more and more uses of electricity are adopted on farms, there is increasing need for adding to the existing wiring or even for rewiring farmsteads. It is probable that there is no single solution to this problem, but one which deserves attention is the possibility of using higher voltages for some farmstead operations. Another possibility lies in exploitation of differences between wiring circuits which serve only control processes, such as extension of switching services, and circuits necessary to carry adequate voltage and current to the operating equipment.

It is possible that new and continuing observations of electrical equipment and typical rural lines should be established in several parts of the country comparable to the test-demonstration lines which were so useful 20 to 30 years ago. The purpose now should be to study the electric energy demand characteristics of certain individual items of equipment, of entire farmsteads, and of their combined demands imposed on distribution lines.

There are developing in many areas of the country large seasonal differences in demand on the electric distribution systems. For example, there are areas with a peak load for three months due to irrigation pumping and air conditioning. That means that the generating and distribution facilities and much of the farm wiring are available for other large uses for nine months. It is conceivable that heating of farm residences might be an excellent use of energy to take advantage of the installed generation and distribution capacity during those nine months. It may be suggested that for all parts of the country, a major problem in the field of rural electrification might very well be a study of the month-by-month energy requirements of well-designed houses for both summer cooling and winter heating, as a basis for determining economical levels of heating and cooling wholly or partly by electric energy. There would be, for each area and different climatic situation, a cross-over point as between investment in insulation and other heat-flow barriers vs. investment in heating and cooling equipment and associated running costs.

House heating or house cooling is suggested for study as only one major use of electricity big enough to develop contra-seasonal uses large enough to more nearly bring into balance the uses of installed capacity throughout the year. One of the major jobs for agricultural engineers is to study

the performance, load, and line-demand characteristics of new or unusual uses of electricity on rural lines to develop data from which distribution companies and public utility commissions may establish favorable or promotional rates for such new uses.

An extensive survey conducted in 1955 by the Rural Electrification Administration, to discover what types of major items of electrical equipment farmers expect to purchase in the next 10 years, points to considerable expansion of uses of such equipment. However, there is a challenge to agricultural engineers in the fact that this survey showed expectations of spending about 10 times as much on household equipment as on items directly related to farm operations. It is desirable, of course, that farm homes get washing machines, television sets, or air conditioners just as fast as they can be afforded and for the same reasons that urban homes purchase such equipment. Agricultural engineers should, nevertheless, ask themselves whether the relatively low level of expenditures intended for farm uses does not indicate the necessity for much more study on how to apply energy in the extremely versatile forms available from electricity to a great many more farm uses.

Solar Energy

Agricultural engineers have not yet given sufficient attention to solar energy. Within the latitudes occupied by the United States, solar energy received by south-facing tilted surfaces, e.g., barn roofs, is of the order of 2,000 or more Btu's per square foot per day. The general problem in use of solar energy is its accumulation. Farms generally have large building surfaces exposed to the sun. Agricultural engineers have done considerable work to offset the heat accumulations of these exposures! Should not attention be turned to collection and practical uses of solar energy for a variety of farm processes through adaptation of farm structures and electrical controls and equipment for that purpose?

Many farm energy requirements are quite large in total but not necessarily large per day. Grain drying, for example, is a process requiring considerable total energy but, properly handled, the operation may be extended over many days. This suggests that agricultural engineers should investigate the utilization of solar energy through the design and installation of structures, plus electric motors and fans, and perhaps heat accumulators, operating under the control of thermostats and humidistats to regulate and control the flow of air automatically in terms of temperature and humidity both outside the grain drying structure and within the mass of grain. Similar studies are in order for integration of structures and equipment operating under automatic controls for the utilization of solar energy for controlled ventilation of animal shelters and heating of residences. This research should extend to methods and limitations of accumulating solar energy in water for washing or processing uses.

Fig. 5 Harvester developed by the U.S. Department of Agriculture to help make castor beans into an economically competitive crop

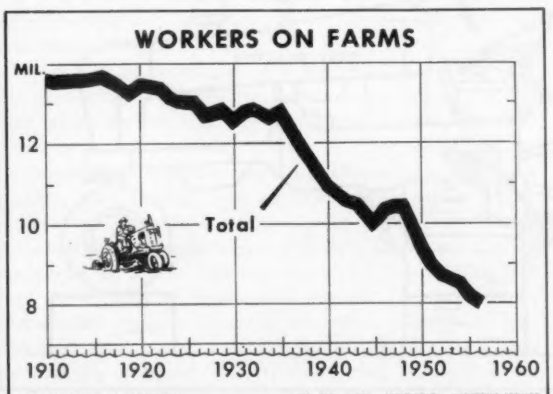


Fig. 6 It is expected that farm labor will become more and more scarce in the years ahead

Source and Supply of Engineers

It has not been possible in this brief review to cover all of the factors which will be influencing the nature and scope of agricultural engineering in the future. Enough has been said, however, to indicate that those who are going to be "tomorrow's engineers" should become increasingly perceptive of, and responsive to, changes which are being foreshadowed by scientific and economic developments. Research in farm machinery will be a necessary part of bringing many of the results of plant breeding and plant introduction into use as practical farm crops. Farm structures may be expected to change quite radically as the full implications of findings from research into the physiological requirements of animals are incorporated into farm buildings. Similarly, knowledge arising from research in the processing of farm crops, and research in the handling of materials will bring major modifications in farm buildings. An increase, perhaps an accelerating increase, in problems of applying energy in new ways is to be expected.

All of this means that the agricultural engineer of the future must be trained more deeply in the physical sciences,

(Continued on page 521)

Accelerated Testing:
A Development Tool

R. N. Coleman

Accelerated testing is merely a tool, subject to the shortcomings of those who use it. However, its value as an advance performance and endurance indicator is without equal. The author describes the various testing methods being used for farm tractors and component parts

IN A broad sense all laboratory testing of farm tractors can be referred to as accelerated testing. This because all laboratory testing is for the purpose of determining whether the product will fill the needs of the customer without waiting to hear directly from him. Laboratory testing can, however, be broken down into the following classifications:

(a) Performance testing

(b) Endurance testing

(c) Accelerated testing

Accelerated testing in this classification is intended to refer to testing wherein the imposed loads, the frequency of load application, and/or the environmental factors are over and beyond those encountered in customer service. The object, of course, is to reduce the time. This testing technique is a very valuable tool. It is well to remember; however, that it is only a tool, and as such its value is largely dependent on the person using it. The validity of this statement will be substantiated further on in this discussion.

Paper presented at the Quad City Section of ASAE in Moline, Ill., January 1957.

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TECHNIQUES FOR ACCELERATED TESTING OF FARM TRACTORS

When considering the complete tractor, there is no easy method of imposing a greater torque load in a given gear than does the farmer; however, it is possible to devise techniques for maintaining the torque loading at or near the peak for a greater period of time. For instance, a number of accelerated tests can be performed by using what is called a "back-to-back" setup (Fig. 1). In this arrangement a test tractor is loaded by a tractor load machine through direct tire to tire contact. The external forces imposed on the test tractor are similar to those encountered in the field, i.e., the forces at the axles are forward and the forces at the drawbar are backward.

This is quite important because one of the big problems in gearing is to obtain even load distribution across the face of the teeth. Any deflection vitally affects these contacts and, if the accelerated testing does not take this into consideration, the results may be misleading. The load machine in this setup is nothing more than a tractor with the engine replaced by a power absorption unit. The test tractor can be loaded in any gear by selecting the appropriate gear in the load machine which will give the desirable rotating speed to

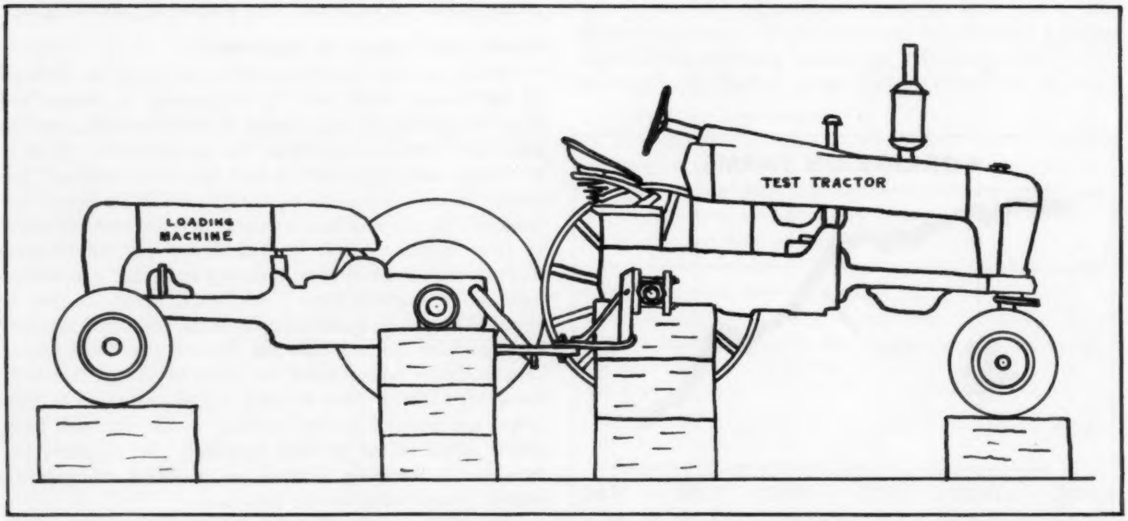

Fig. 1 Back-to-back setup for accelerated testing provides for a test tractor to be loaded by a tractor load machine through direct tire to tire contact. External forces are similar to those encountered in the field, in that, the forces at the axles are forward and those at the drawbar are backward

Fig. 2 This method permits testing of tractor in operation at, or near, full load for long periods of time

the power absorption unit. Arrangements can be made for shifting gears, actuating clutches, and varying the power load or torque load automatically. The setup is such that it does not require the continuous attention of a tester, in fact, one tester can handle a number of such setups. The power load can be maintained at a continuous high level, which is one means of accelerating a test. The frequency of shock load application, such as by engagement of clutches, etc., can be used to accelerate the tests. It is even possible to emphasize environmental factors by enclosing the setup for temperature control, dust concentration, etc.

This back-to-back setup has a disadvantage in that no data concerning operator comfort, ease of handling, etc., is obtained. A technique more widely used than the back-to-back setup is one in which the load machine is used as a drawbar load. The test tractor is operated in a normal manner except the operation is at or near full load for a much greater portion of the time than in regular customer service. Accelerated tests on the final drive components can be obtained by using high ballast loading to obtain added traction so that the lower gear ratios can be used. This technique produces greater final drive torque loads than those obtained in general farm use. In the higher gear ratios, it is possible to accelerate the testing by increasing the power loading and frequency loading through use of higher than normal engine speeds.

It should be stated that it is the usual practice in this type of testing to use the tractors in actual farming operations when weather and crop conditions permit. The load machines are used as a fill-in when farming operations are not possible. A hard-surfaced (asphalt-concrete) test track provides good traction with correspondingly higher torque and power loads over a wide range of weather conditions. It also provides operation on a 24-hour-a-day basis. It is the opinion of the author that *any accelerated test program that does not include a considerable amount of actual tractor operation by qualified testers is not sound.* There is no substitute for objective observations by qualified testers. Their observations of sound, feel, visibility, etc., are factors that easily are overlooked in purely automatic testing setups.

Other external loads that must be considered are those encountered from the jolts and jars when operating over rough terrain. This has come into much sharper focus in recent years due to the increase in use of mounted equipment. To accelerate tests of this nature, it is always a problem to find an area where the severity of the terrain can be controlled so that test results can be repeated. A special torture course is used by International Harvester Co. The course is basically a 12-ft concrete roadway which has angle iron imbedded in the concrete along the edge of the roadway. Obstacles of any nature and number can be anchored to the angle iron. The test results can be duplicated. Most of the work on this test course is performed with obstacles similar to those encountered in going across rows in the fall season. It has been found that 25 to 50 hours of operation on this course is sufficient to determine weaknesses that will cause concern in the field. It is known that at least three tractor manufacturers are using a torture course of this nature.

Component Parts Tested on Tractor

Specific tests on the complete tractor are also often conducted just to obtain an accelerated test on one of the components. Brakes are tested by running in a figure "8". The right brake is applied at the one end of the figure "8" to assist in turning. The left brake is applied at the opposite

Fig. 3 A torture course furnishes the jolts and jars normally encountered over rough terrain

end. The severity of the test is controlled by varying the length of the figure "8" made by the tractor. Information with regard to wear and fade characteristics is obtained.

Similar tests are also run on clutches. A heavy inertia load either on the drawbar or belt is best suited for this. The number of clutch engagements can be increased many fold over what is encountered in customer service. A relative measure of wear and fade characteristics is obtained.

Tests on power take-off or belt pulley assemblies can be obtained by absorbing the power from these outlets by means of the loading machines. The tests are accelerated by using a higher than normal power load and by repeated engagement and disengagement.

Testing Component Parts Individually

Accelerated testing techniques are most widely used for testing component parts. Individual gears, combinations of gears, and complete transmission units are developed by means of the well known "four-square" setup. Much comparative information is obtained with regard to the factors that improve the wear and the bending fatigue characteristics of the gears. It is not uncommon to use gear loadings as high as 50 percent above normal as a means of accelerating the tests. When testing a complete transmission unit by the four-square method, it is important to carefully consider the arrangement of the setup. This, so that deflections will be similar to those encountered in actual service. The four-square setup is similar to the back-to-back setup of the complete tractor previously discussed. The four-square setup can have a higher degree of acceleration because its loading is not dependent on the power source.

Electrical components such as magnetos, distributors, generators, and starting motors are tested on bench setups whereby load, rotating speed, and environmental factors can be modified to obtain accelerated tests.

Clutches are developed on accelerated testing fixtures which may use an electric motor or an engine as a source of power and an inertia unit for load application. The general testing procedure is not significantly different from the accelerated clutch tests that are run on the complete tractor; however, a much closer control of the variables is possible. For instance the rate of clutch engagement, frequency of engagement, rotating speed at time of engagement, and environmental factors can all be controlled within close limits.

Accelerated tests on the engine only are run by coupling to a dynamometer and operating at high average load, under controlled environmental conditions. The specific objective of a test might be concerned with very light load operations, if so, the test can be accelerated by operating at very light loads continuously.

All tractor controls, instruments, etc., are subjected to accelerated testing techniques whenever questions concerning their performance or life may arise. The same general accelerating techniques are used, i.e., external loads greater than normal, environmental factors more severe than normal, or frequency of load application greater than normal are applied.

The hydraulic systems are subjected to accelerated tests by providing a source of power input to the pump and some means of actuation to the hand controls. Operating temperatures, frequency of load application, magnitude of load, abrasives in the hydraulic fluid and other items can be altered to accelerate the testing.

Dozens of other examples could be cited, and the same general techniques would be apparent.

It is difficult, if not impossible, to devise an accelerated procedure that will reveal all the weaknesses or merits of a tractor or even a component part of a tractor. In fact, final selection of a design is seldom based on an accelerated test. It is best to think of accelerated testing as a development tool rather than as a method of final evaluation.

To further explain, consider the evolution of the farm tractor as it is known today. Experience has indicated the type of failure usually encountered in each of the components. Accelerated tests are developed so that similar failures can be produced in the laboratory. The tests in the laboratory seldom give equal weight to all the factors involved in actual operation. It is, nevertheless, possible to obtain a measure of the relative merits of various ideas to improve the weakest link. The ideas showing no merit can be discarded quickly and the thinking for further ideas is stimulated. As soon as the weakest link in a component has been strengthened to the point where it is no longer a major factor of concern, the accelerated testing procedure can be modified so that the next weakest link can be considered. Thus, accelerated testing is most useful when considered as a development tool.

Accelerated testing is also used, to some extent, to compare components of different manufacture so that a final selection can be made. It is in this area that the results are most likely to be questioned. The reason for this is that even though the results may be valid as a direct comparison under the conditions of the test, they do not necessarily show that the second best in the test is not entirely satisfactory for customer service.

Questions also are asked with regard to how much service a test represents in actual field operation. Answers to such questions are only guesses. The results of accelerated laboratory testing are only comparative and then only under the conditions of the test. There may very well be factors during customer service that are not taken into account. For instance, a gear train may be subjected to an overload type accelerated test and appear to be capable of withstanding any anticipated load in the field. Field experience may then reveal very short life due to moisture condensation in the lubricant resulting in severe corrosion. When this occurs it is easy to devise another accelerated test that emphasizes this environmental factor.

Many instances could be cited where an accelerated test did not reveal a weakness that caused major concern in actual field service. Does this mean accelerated testing techniques should not be used? Certainly not. It merely means that accelerated testing should be used basically as a development tool as has been previously noted. Along this line of thought, the following is quoted from a paper by D. R. Richardson and G. R. Fuller, Caterpillar Tractor Co.*

"Usually, the results of accelerated testing must be verified by normal testing if the accelerated test is to be considered valid. In some accelerated tests, however, the results are compared only to the results of other accelerated tests. The comparative results may indicate that one part is su-

*Paper entitled "Accelerated Testing of Tractor Components" was presented at SAE Tractor Meeting, Milwaukee, Wis., September, 1953.

perior to another, but may not indicate the extent of superiority. The final evaluation must come from the results of normal testing. In either case, accelerated test results must be reproducible and viewed with caution until verified."

It is inconceivable that the improvement of power-to-weight ratio obtained in farm tractors would have been possible without accelerated testing. The first question that enters an engineer's mind when a weakness is indicated in actual service is: What accelerated test procedure can be devised so that ideas of improvement can be compared directly? If such procedures were not possible, it is quite likely that a company would be out of business before an improvement could be developed.

. . . Opportunities

(Continued from page 517)

mathematics, and basic engineering. He must, also, be so trained and so conditioned in his thinking that he will quickly see and readily follow the implications of research and developments in biological sciences and in economics.

One of the most important questions concerning tomorrow's agricultural engineers is, Where will they come from? As a nation, we are in a period of unparalleled prosperity marked by minimum unemployment and a very high rate of technical and industrial expansion. There is an unprecedented demand for technicians and engineers marked by intensive recruitment efforts by many industries on all campuses where engineers are being trained.

Another of the basic underlying factors which will affect the framework in which agricultural engineering will operate for years to come is that, as a nation, we are in a phase of labor scarcity, due to the low birth rate in the 1930's which has resulted in relatively small numbers of persons 18 to 24 years old now coming into the total labor force of the country. One consequence is high and rising wages which will attract labor from farms. Even though farm wage rates have risen sharply, it is to be expected that farm labor will become more and more scarce in the years ahead.

This decline in availability and rise in cost of farm labor creates a great opportunity for agricultural engineers. Any period of rise in labor costs and increase in labor scarcity creates an opportunity for, and demand for, engineering advances and industrial developments to compensate for the labor which has been lost.

It should be noted, however, with special reference to agricultural engineering, that the same factors which are creating an opportunity for agricultural engineering developments may pose very difficult recruitment problems. The declining number of farms means a smaller number of farm families from which young people may come to college. It is to be expected that the number of young people coming to agricultural colleges will be relatively a smaller percentage of college students and may, perhaps, be absolutely fewer in number. Of this limited number, those who are "engineering minded" will be tempted, for at least the next several years, by intensive recruitment from many non-agricultural industries.

Not only may it be difficult to develop a supply of agricultural engineers equal to the opportunities ahead for that profession, but also the same factors will hamper the development and maintenance of the supply of college teachers necessary for the development of agricultural engineers with superior undergraduate and high-quality graduate training.

The need to substantially increase the supply of scientists and engineers has resulted in efforts to attract more young people into those careers. Business, professional societies, the National Science Foundation, the National Research Council, and others are making notable contributions. Engineering enrollments are rising, and larger numbers of graduates are already being made available to industry. Yet more must be done in general, and especially in the field of agricultural engineering.

The needs for agricultural engineers for teaching, for industries, and for direct services to farmers, such as rural electric service engineers, soil conservation district technicians, etc., should be supplied largely from the Land-Grant Colleges and Universities and must be drawn from a comparatively shrinking source of students. It seems pertinent, therefore, to suggest that the following steps might be taken in the Land-Grant Colleges and Universities and by agriculture-related industries:

- Recognize the peculiar characteristics and needs of *agricultural* engineering as contrasted to other engineering fields which may be absorbing more students. While the latter deserve all possible support, few lines of engineering other than agricultural depend almost solely on land-grant colleges and universities. In view of this special and peculiar responsibility, administrative measuring sticks, such as students-to-teacher ratios, should not be applied to the disadvantage of agricultural engineering.
- Unload teachers from too-heavy research or extension programs, so that they may carry on adequate self-improvement and have time, energy, and enthusiasm for superior teaching.
- Seek relations with industries, and with outstanding agricultural engineers currently in industrial employment, through which plural jobs can be established, as in some other branches of engineering. Under this a man may be largely an industrial employee but devote a significant part of his time to teaching, or he may be basically a college teacher but allowed and encouraged to spend considerable time in and gain substantial income from private employment or consulting work. The advantages to be gained would be, in part, sufficient income to the individual to offset the lure of full-time industrial employment; a sharpening of perception and broadening of experience of the teachers so employed; and a measure of direct aid from industry to help develop the quality and numbers of agricultural engineers that many industries will be needing.
- Seek to establish scholarships and fellowships adequate in numbers and values to attract and sustain many more students through courses of study for Master of Science and Doctoral degrees in agricultural engineering.

The ways in which industries may help to establish and implement programs to carry out some of these suggestions are quite obvious. And to numerous agriculture-related companies and industries it may be said that their own self-interests should dictate willing cooperation, or even initiation of actions in some cases.

Engineering Problems in Pelletized Feeds

H. D. Bruhn
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When man tampers with nature's way of doing things he must also investigate or take into account all possible ramifications—good or bad. The author presents a summary of some nutritional studies having effect on the engineering aspect of feed and forage harvesting and processing equipment. Particular reference is made to dairy cow requirements

THE individual kernel of corn or grain is nature's version of a pellet and has proven satisfactory for the purpose for which it was intended. However, when man desires to combine or change the ingredients of the natural pellets, his only alternative is grinding, mixing, and then reconstituting the pellets.

Pelleting of certain feeds for livestock and poultry is an established practice. Probably the major reason for pelleting has been to make a ground feed ration more convenient and pleasant to handle and to increase the palatability of the feed and prevent waste and sorting by the consuming livestock or poultry.

There are other physical advantages in pelletized feeds; usually the density is greater with a resultant saving in storage space or bag cost, there is less loss in the form of flour and dust, and the material flows more easily from bins and is convenient to move with conveyors.

Pellets are made in a variety of sizes, ranging from 3/32 to 2 in. in diameter and in various shapes such as cylinders, cubes, rectangles, or even stars. Within reason pellets of almost any size or shape can be made. Some feeds are made first into pellets and subsequently crumbled and screened to the desired size.

Generally, the material to be pelletized is first ground in a mill (usually a hammermill), then mixed with other materials to obtain the desired ration, after which the mixture is pelleted with the addition of water or preferably steam to aid in the pelleting process. The pellets are then dried and cooled to dissipate the heat, some of which came from the steam and some from wasted energy in the pelleting process.

In some cases a binding agent such as molasses may be used, although it is not required, for many materials are pelletized with no special binding agent other than the normal constituents of the feed.

Paper presented at the winter meeting of the American Society of Agricultural Engineers in Chicago, Ill., December, 1956, on a program arranged by the Power and Machinery Division.

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Acknowledgments: The author wishes to acknowledge the assistance of N. N. Allen and Robert Niedermeier of the dairy husbandry dept., and M. L. Sunde of the poultry husbandry dept., University of Wisconsin.

Short-chopped forage crops such as alfalfa and clover can be fed directly into a conventional pelleting machine. However, if this procedure is followed, the output of the pelleting mill is greatly reduced as compared to the process of pelleting ground material. This is partially due to the large amount of energy used in grinding the chopped forage during the pelleting process. The grinding taking place in a pelleting mill is an inefficient operation, and the energy used for grinding is not available for pelleting. Obviously, this is one of the reasons for the reduction in capacity of a given machine when an attempt is made to pellet chopped forage in a conventional pellet mill. The output of a pellet mill may be in the range of 25 lb per hp-hour of unground material while with ground material the output may be in the range of 100 to 150 lb per hp-hour.

In addition to the grinding, heating, steaming, cooling, and drying taking place in the material as it passes through a pellet mill there may be, in some machines, a change of state due to the localized pressure exerted to the product during the pelletizing process. Exactly what effect this may have on the palatability, feeding value, and digestibility has not been thoroughly determined, although the agricultural engineer has only to look at current issues of such publications as the *Journal of Animal Science* and the *Journal of Dairy Science* to determine the great deal of interest among animal nutritionists in the efficiency and performance of pelleted rations as compared with similar rations fed in the natural state or as ground meal. Many other reports center around studies on the physical characteristic of roughage in the ration and its effect on rumen function. The designer of pelleting equipment may be advised to keep himself well informed on recommendations of these investigators.

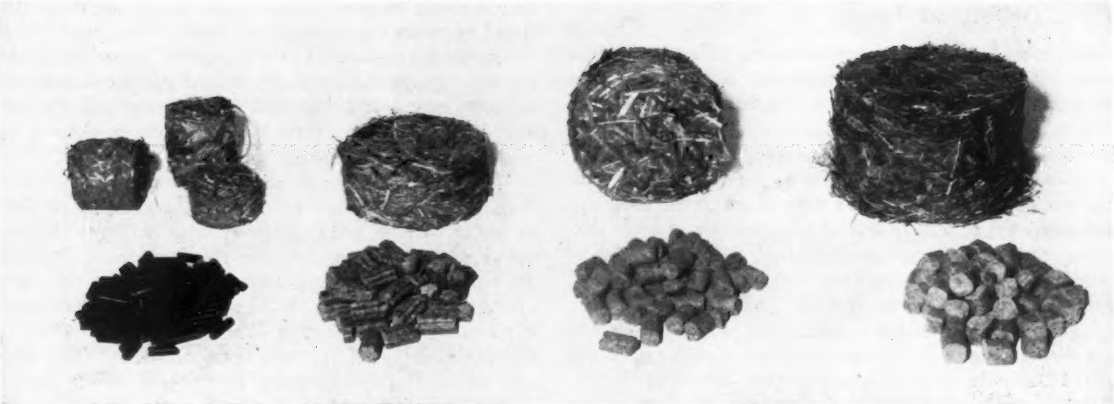
Pellet Feeding of Livestock and Poultry

Dog food has been pelletized to increase the palatability and convenience in handling over that of meal.

Pellet feeding of broilers and pheasants is a standard practice, and it is a recognized fact that they do better on pellets. Because of the greater density of pellets the birds may get more feed in a given period of time. In some cases there has been noticed a greater tendency toward pecking (cannibalism) in pellet-fed broilers; the faster rate of filling up may leave more time to peck around.

Allred (1)* reported increased gains on broilers fed pellets as compared with meal. Also, when the pelletized feed was reground to a density comparable to that of meal, the broilers did better on the ground pellets than on the meal. Thus, there is evidence that the greater density of pellets is not the only factor involved in the better growth. Allred's studies showed that corn was the ingredient improved by the pelleting process.

*Numbers in parentheses refer to the appended references.



These pellets are representative of two types of pellets referred to in this paper. The lower row of pellets range in size from ¼ to ¾ in. in diameter. They were made of ground material with conventional pelleting equipment. Since the alfalfa used in these pellets was finely ground they are not desirable for dairy cows but are suitable for some other livestock. The pellets in the upper row range in size from 2 in. in diameter to 5¼ in. in diameter. These were made with experimental equipment from chopped alfalfa. Preliminary feeding trials indicate that these appear to be satisfactory for feeding dairy cows.

Equally interesting reports are available on the feeding of pelletized rations to ruminants.

Neal (2) has reported that less pelleted alfalfa was required by lambs to produce a unit gain. Bell *et al.* (3, 4) reported greater rate of gain and less feed required per unit gain on lambs fed a pelleted ration. Jordan *et al.* (5) reported that pelleting good palatable feeds such as corn and alfalfa increased efficiency slightly. Cate *et al.* (6) reported for lambs that when timothy was used as roughage in the ration, pelleting significantly increased average daily gains, feed consumption, and carcass grade, but that when alfalfa meal was used little difference was effected by pelleting. Lambs on the pelleted rations reached market at 56 days in greater proportion than similar lambs fed the same ration in meal form. Feed required per 100 lb of gain on lambs was lower for all pelleted rations, with the greatest advantage occurring on the lowest quality ration.

The University of Illinois Dixon Springs Station report (7) indicates a "lot" of lambs self-fed a complete pelletized ration was outstanding in rate of gain, rapidity of finish, carcass grades, dressing percentage, and feed efficiency as compared with a similar lot fed the same ration not pelletized. Ninety pounds of pellets produced the same gain as 100 lb of meal. This advantage, however, was not enough to pay the cost of pelleting.

Long *et al.* (8) reported that grinding the complete ration for lambs reduced the digestibility, and pelleting restored it to equal that of natural state.

Lindahl *et al.* (9) reported that pelleting reduced the moisture content even when steam or water was added in the process and also tended to increase the ether extract and decrease the crude fiber.

Thomas *et al.* (10) found that lambs fed a pelleted ration gained faster, sold for a higher price, and their carcasses graded higher than lambs fed a whole grain and hay ration; however, here again the greater gain was not enough to cover the cost of pelleting.

Another Dixon Springs Station report from Webb and Cmarik (11) indicated that yearling steers fed pellets gained more on less feed than steers fed the same ration of meal. The selling price of the pellet-fed steers was slightly higher, although the carcass grades and dressing percentages were essentially the same. On the basis of performance the pelleted feed was worth $6.39 per ton more than the meal, less the cost of pelleting.

Again from the same station a report (12) comparing steer calves wintered on a timothy-alfalfa mixed hay ration fed free choice shows that calves fed pellets consumed approximately 50 percent more dry matter and made 90 percent greater gain per ton of feed than calves on either baled or chopped hay.

Gardner *et al.* (13) found that dairy calves ate more pelleted hay than long, chopped, or ground hay, and the consumption of calf starter was the reverse of hay consumption. In a repetition in a second year with a different source of alfalfa hay these investigators found that calves on pelleted hay ate more hay and less calf starter than those on the chopped hay, and the gains on pellets were slightly over those on chopped hay.

Hibbs *et al.* (14) increased the growth rate in dairy calves and hastened the development of an early mature type rumen function by rumen inoculations to provide an early reliable source of rumen microorganisms and the feeding of a reduced-cost, high-roughage ration of two parts of coarsely ground alfalfa and one part of a simple grain mixture pelleted to prevent selective eating. This feeding system brought about an early dependence on rumen digestive and synthetic processes.

Special Requirements of the Dairy Cow

The feeding of completely pelletized rations to dairy cows has not proven satisfactory in the past. These rations have been made up of ground concentrates and finely ground alfalfa meal.

Powell (15) reported that dairy cows fed a complete pelletized ration gave milk of lower butterfat content. For example, a cow giving milk with a 3.8 percent fat content dropped to a 2.6 percent test. When only 5 lb of long alfalfa hay were added to the daily ration the fat content was raised to 2.9 percent and when the cow was put on a regular ration of long hay the fat content of the milk again returned to the normal of 3.8 percent. The above is the record of a

single cow; however, it is representative of many duplications. Not only could the butterfat test be depressed for a short time, but a cow could be carried through several lactation periods with the depressed test and then brought back to normal by feeding a regular ration.

Powell (16) reported also that a similar decrease in milk fat was observed on cows fed diets in which the roughage was restricted to 6 lb or less of long hay per cow per day. These results were confirmed by Loosli *et al.* (17) and by Stoddard (18, 19) feeding only 3 to 6 lb of hay daily with generous amounts of concentrates.

Subsequently it became apparent that pelleting itself was not the factor responsible for the decrease in milk fat. Work at the University of Wisconsin under the direction of N. N. Allen (20) has shown that it is the fine grinding of the forage that brings about certain abnormalities in the rumen digestion leading ultimately to reduced milk fat content similar to that of animals receiving very reduced roughage intakes but generous amounts of concentrates.

In the normal process of digestion, forage consumed by a dairy cow enters the rumen (first and largest compartment of the cow's four-chambered stomach) in a fairly coarse state. An important part of the digestive process in the rumen is the decomposition of the forage by microorganisms. This breakdown and the normal cud chewing of the dairy cow in due time reduces the forage to a rather fluid state, and then it passes on to the second compartment of the stomach, the reticulum. The time required for this portion of the digestive process may require from 24 to 72 hr. During this time the microorganisms digest the nutrients of the feed and convert portions of the forage into other compounds. The cow, in turn, utilizes not only the waste products of the microorganisms but also the tissue.

Of the many compounds synthesized by the microorganisms, of major economic importance are the fatty acids. Tyznik (21, 22) has shown a close relation between the amount and kind of forage supplied to the dairy cow, the fatty acids in the rumen, and the butterfat content of the milk. When the forage was limited to 3 lb of long hay daily, the relative fatty acid ratio in the rumen was changed from a normal of acetic 65 percent, butyric 20 percent, and propionic 15 percent to a situation where the proportions of acetic and propionic were reversed and propionic became the predominant acid. At the same time there was a drop in the butterfat content of the milk. When as much as 30 lb of finely ground alfalfa was added to the ration, there was no change toward normal in either the fatty acid ratio in the rumen or in the fat content of the milk. However, the feeding of alfalfa hay quickly returned the cows to normal.

An interesting side light of this work was the observation that, although the fat content of the milk was low while the cows were on rations of either restricted roughage or liberal amounts of finely ground alfalfa, the cows generally put on weight during the test, indicating an adequate total energy intake. The quantity of milk produced was comparable to cows fed normal intakes of roughage.

Rodrique (23) indicates that a major reason cows on a finely ground alfalfa ration react similarly to those on reduced roughage may be that the finely ground forage passes from the rumen too quickly for proper action of the microorganisms and subsequently there occurs a change in the fatty acids of bacterial origin in the rumen similar to that found on the restricted roughage diets.

In his studies involving the relation of fineness of grinding of roughage to digestibility, rate of passage through the digestive system, and degree of depression of milk fat content, Rodrique has set forth in a very concise manner the marked effect of increasingly fine grinding:

"Within the range included in this study there was a definite, relationship between fineness of grinding the hay, its rate of passage, and digestibility of its nutrients. In a ration in which roughage furnished the main part of the daily dry matter intake, a finer grinding of the hay was associated with a greater depression in digestibility of the total ration and a faster rate of passage. The most marked decline in digestibility is that of the crude fiber or cellulose. This characteristic decline brings about a condition in the animal marked by a significant decrease in milk fat percent."

Rodrique's studies involved the feeding of long hay and ground hay of three degrees of fineness as indicated by determining the percentage of material retained on the 20, 40, 60, 80 and 100 U.S. Standard sieve series.

Tyznik (21, 12) has indicated that the acetic acid content of the rumen is more closely related to fat content of the milk and that cows on a low forage or finely ground forage ration could be brought back to normal by feeding acetic acid or sodium acetate. No increase in milk fat content could be obtained by feeding sodium acetate to normal cows on a regular hay ration.

Powell (24) was able to improve the depressed milk fat content of cows on a low-roughage (6 lb daily of normal alfalfa) ration with full-fed concentrates by fermentation of the concentrates for 48 hr at 100-110 F.

As a result of the studies of Powell, Allen, Tyznik, and Rodrique, it appears rather obvious that alfalfa in a finely ground state, whether in meal or in pellet form, is not desirable as a feed for dairy cattle.

Exactly where the break point may be on fineness of grinding has not as yet been determined. There probably is a point to which hay may be ground without serious milk fat depression and yet allow a higher efficiency of pelleting over that of unground forage. This point may be somewhere in the coarse grind range (20).

In fact, the failure of Stoddard (18) to obtain the depression in milk fat content on one of his experimental rations has been attributed to the fact that the mill used for grinding did not produce a meal as fine as commercially ground alfalfa meal. As mentioned, Hibbs *et al.* (14) used pellets of coarsely ground alfalfa and simple grain mixture in their ration designed to produce early rumen development and function in calves.

If forage crops are to be pelletized for dairy cows, it is quite obvious that the pellets should be made of either coarsely ground or chopped hay, first, because of the reaction of the cow to finely ground forage, and second, because of the high cost of fine grinding and pelleting in the small sizes.

Larger pellets can be made of chopped or long hay. At Wisconsin (25) pellets made of chopped and long alfalfa approximately 2, 4, and 5 in. in diameter have been fed to Holstein cows, and the cows seemed to show little preference as to size when fed a mixed sample. Pellets with an individual pellet density of approximately 40 lb per cu ft were consumed readily. When given a mixed sample of the same sized pellets (2 and 4 in.) varying in density, the Holstein

cows seemed to make no attempt to pick the softer pellets, although they seemed to have slightly more difficulty breaking up the harder pellets. Brown Swiss cows also have consumed pellets readily. However, some Jersey cows appear to have a little more difficulty eating large pellets.

Cost of Pelleting

Since many of the investigators mentioned previously in this paper have found that the increased efficiency of pelleted rations for livestock feeding is offset by the cost of pelleting, a consideration of pelleting costs would be in order here.

The charge made for pelleting feed varies considerably. In some cases the price seems to be as high as the traffic will bear; in other cases the price of pelletized feed is essentially the price of meal plus the actual cost of pelleting with a reasonably small profit; and in some cases pellets and meal are the same price.

The actual cost of pelletizing a feed already in the meal state is not excessive. It depends, of course, on the material and the type of pellets desired. With 10 to 20 hp-hr per ton required for pelleting some millers charge $1.00 per ton for this service. Others charge $2.00 per ton. The cost to grind and pellet a forage crop, however, as compared with chopping forage is an entirely different matter. Direct pelleting without grinding may require four to six times the power required for pelleting a ground product, and grinding forage before pelleting involves additional equipment and an additional operation. Where large quantities of alfalfa are pelleted, grinding prior to pelleting is usually practiced, in spite of this extra equipment and additional operation, because of the overall power saving and higher plant capacity.

Grinding forage is a high-power consuming operation (15 to 30 hp-hr per ton). It is exceedingly high if the grinding is fine. Furthermore, as has been shown, fine grinding of forage, especially for mature, milk-producing ruminants is of questionable value.

Additional study on pelleting and feeding mixed rations may reduce the cost. The use of more coarsely ground materials in the pelleting process might make the practice economically sound under such conditions where it is found that the higher cost of grinding and pelleting finely ground materials offsets the increased profit from increased rate of gain and early marketability of meat animals fed the pellets.

Field Pelleting in Large Sizes

As a forage harvesting and curing procedure, the making of large pellets of partially field-cured hay to be finally cured by artificial means offers considerable promise.

Field-pelleting of forage in the large sizes (2 to 6-in pellets) obviously will require more power than chopping or baling because of the greater density of pellets. The process by which the pellets are made will, of course, affect the power required. Preliminary tests indicate that it should be possible to field-pellet chopped forage in large pellets with about double the power of baling. Thus, such a machine is entirely within the realm of possibility both from the standpoint of power consumption and from the standpoint of producing a nutritionally satisfactory product for dairy cattle.

Note on Bibliography

In presenting this material the author has made an attempt to set forth fairly and briefly a summary of a limited part of the nutritional studies having an important bearing on and a relation to the engineering aspect of feed and forage harvesting and processing equipment. In selecting such a necessarily limited portion of each of the individual's works, undoubtedly some important factors have been overlooked. Therefore, it is recommended that those who work with equipment, the success or failure of which may depend on the principles discussed herein, be urged to better acquaint themselves with some of the excellent works listed in the following bibliography.

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GOLDEN ANNIVERSARY FEATURE:

Evolution of Grain Drying

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ONE of the first industrial operations I ever heard of at home in western Oregon was a prune drier. Every once in a while it made news when the plant or part of it burned down and had to be rebuilt. This was in the period before World War I. At the same time almost every hop yard had a hop drier that operated for a few weeks during the fall. Unknown to me, some terminal elevators and grain handlers were also equipped with driers for conditioning grain that was too damp to store or handle without danger of spoilage. This was before the general adoption of the combine for harvesting grain. Even before the combine harvester, moisture problems with stored grain were not unknown. During that period little if any grain was dried mechanically on the farm. The nearest approach to it was perhaps the practice of hanging in the attic those ears of corn selected for next year's seed.

As the combine harvester became more common there were many scattered trials of farm grain driers. In the January 1928 issue of AGRICULTURAL ENGINEERING there was published a report of a symposium on the latest developments in grain drying. This included reports on grain drying tests from several of the states.

Meanwhile the hybrid seed corn industry, handling a crop with a high per bushel value, equipped itself with heated air driers and used them as a routine part of the seed corn processing operation almost from its start. The corn was usually dried on the ear, using air heated to not over about 110 F.

Largely as a result of pressure for profitable uses of electricity a large amount of work was done on methods and equipment for drying hay in the 1930's. The early applications of barn hay drying were with unheated air, and in some areas mow hay drying was a fairly common practice before World War II.

Grain drying on the farm before World War II was limited to a relatively few isolated installations. They did demonstrate that farm drying could be a practical and profitable operation, but it was following the war that grain-drying equipment began to be readily available. Soon after the war manufacturers began making and selling driers which usually consisted of heaters and fans combined into single drying units with suitable controls. Together with unheated air driers, such units comprise the drying equipment available today. At the same time, buildings and materials manufacturers have developed drying buildings, duct systems and various combinations for "package" distribution. About 1951 the Crop Dryer Manufacturers Association was formed.

Paper prepared expressly as a Golden Anniversary feature for AGRICULTURAL ENGINEERING. Journal Paper No. J-3214 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1296. (USDA cooperating)

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Grain drying on the farm is now accomplished almost exclusively by systems in which air having a suitable relative humidity is passed through a layer of grain, the layer being from a few inches to several feet thick. Several other methods have been tested or proposed but have not been worked out for general practical application. For example, the possibility of absorption of moisture from grain directly by chemicals or hygroscopic materials has been proposed. Some work has been done on use of electric induction to supply the heat for vaporizing the moisture from grain. There have also been some tests on use of infrared radiation. Supplying the necessary energy from a heat pump has been given some attention. Use of high vacuum has also been proposed as a possibility but so far none of these proposals has been reduced to general use.

Heated and Unheated Air Driers

Grain-drying equipment using heated air is essentially for fast drying whereas unheated air equipment is for slow drying. The distinction is in the method of use as well as in the nature of the drier. Fast drying, with heated air, permits repeated use of the same grain container during a harvest season. Batches may be dried, the compartment emptied and refilled, or it may be arranged for continuous grain flow through the drier. The drying time varies from an hour or so up to a few days. On the other hand, slow drying, with unheated air, typically requires several days or even weeks before drying of a given batch is completed. This makes it impractical to use unheated air in a continuous-flow or repeated-batch system. Unheated-air drying usually takes place in storage bins from which the grain may or may not be removed immediately following drying. An intermediate class of drying is sometimes used in which a small amount of heat is added, heating the drying air to a few degrees, perhaps 5 to 15 F above atmospheric temperature. This is sometimes called "supplemental heat" drying to distinguish it from "heated air" or "unheated air" drying. While this method makes use of added heat, it depends largely on the heat of the atmosphere to do the drying, and with respect to its use, it is essentially a slow drying process. The main reason for using supplemental heat is to make sure that some drying is taking place continually, even when atmospheric relative humidity is highest.

Slow and Fast Drying

In slow drying systems air is passed through relatively thick layers of grain, up to about ten feet. The grain compartment is usually a modified storage bin, with either a raised perforated floor or a system of ducts on the floor for distributing air. Slow drying is used in all parts of the country but of course is best suited to climates where the humidity is relatively low during the drying season.

Fast drying is sometimes used in storage bins, but when it is, the depth of grain is usually limited to two or three feet

or less. The full advantage of fast or heated-air drying is taken only by drying compartments which are easy to empty and refill, and the tendency in fast drying seems to be away from storage-bin-type compartments toward special drying bins. Such bins take a variety of forms. One type holds the grain in two parallel vertical layers. Heated air is forced into the space between the two and moves horizontally through the grain. The layers may be from 6 to 18 in thick. Perforated sheet metal or screen wire is used for the walls of the grain compartments. In this type of drying bin there may be a hopper overhead to hold a batch of undried grain so that the drying compartments can be refilled quickly after a dried batch has been removed. This type of bin can be operated as a continuous-flow drier if provision is made for removing grain continuously from the bottom of the bin. Variations in this type include a diamond-shaped bin in which the grain compartments are sloping rather than vertical.

In another type of drying bin for fast drying the grain is held in a rectangular-box-like compartment. Inverted *V* ducts, open at the bottom, extend across the bin at several levels. Half of the ducts are for air to enter and half for exhaust. The air moves both upward and downward through the grain from each supply duct to the nearest exhaust duct above and below. This type of bin may also be operated either as a batch type or in continuous flow.

Various forms of wagon-bed driers are used for fast drying. A layer of grain is spread on a wagon bed with a perforated floor and the drying air is forced upward through it. With several wagons so equipped the drier may be moved from one wagon to another so that little operating time is lost. One wagon-type drier is equipped with a motor operated moving perforated floor so that the grain may be dried in a continuous-flow operation.

Cooling After Drying

When heated air is used for drying it is necessary to provide for cooling the grain after drying. Sometimes cooling is done in the same compartment by continuing to operate the fan after the burner is shut off. In a continuous-flow drier there may be a portion of the drying bin through which unheated air passes, cooling the grain just before it is discharged. Or the grain may be removed from the drier without cooling in which case it may be cooled to atmospheric temperature by air circulation in the storage bin to which the dried grain is moved.

Types of Driers

Heated air grain driers are of two classes, *(a)* indirect, those using heat exchangers and discharging the products of combustion to the atmosphere and *(b)* direct, those in which the products of combustion are mixed with the drying air. For most purposes the presence of the products of combustion does not materially affect the quality of the dried grain. The air temperature used for drying usually is between 130 and 200 F. When it is necessary to preserve the germinating quality of the grain, the heated air temperature must be limited to not over about 110 F. There is still too little information on the effect of drying temperature on feeding value. The effects of temperature on each of the nutrient qualities of grain is complicated, but it is usually assumed that there are no excessive losses in feed value by drying at temperatures up to 150 to 160 F. Wet millers of corn find that corn dried with air hotter than about 130 F is not satisfactory for their processing.

The advantage of using higher temperatures is mainly that as the temperature is increased the bushel per hour capacity of a given size drying compartment becomes greater. The amount of heat required to remove a given quantity of moisture is not greatly affected by the operating temperature. A well-designed unit will evaporate from about 50 to 80 lb of water for each gallon of fuel oil or equivalent heat from another fuel.

The power for air circulation is usually supplied by electricity although some units are equipped for PTO operation. The cost of power for air circulation limits the grain depth at which operation is economical. If greater grain depths could be used, the cost of drying bins of given capacity could be decreased. In this connection an interesting possibility for future development suggests itself. In combustion of the large quantities of fuel required for drying, if a small part of the energy could be converted to mechanical form for providing the necessary air flow, the mechanical efficiency with which the power for air flow is generated would be of little importance. An engine which for other purposes would have too low a mechanical efficiency to have much value might be well suited for forcing air through grain and at the same time heating the air. No equipment utilizing this possibility has been developed and used in present grain driers.

Moisture Migration

A recent development often confused with grain drying should be mentioned here. In storing grain for relatively long periods, that is for more than a few months, even dry grain is subject to moisture migration from one part of the bin to another. This is caused by temperature differences and frequently results in spoilage in upper layers of grain in the bin. Ventilating stored grain with very low rates of air flow has been proven to control this cause of spoilage, and equipment for ventilating stored grain has become common. Since this ventilation is provided by simple duct systems and fans for forcing air through the grain it is not surprising that a grain cooling system is sometimes mistakenly thought to be a drying system. However, volumes of air that are adequate for cooling to prevent moisture migration may be so small as to be useless for drying high moisture grain.

Summary

Development of farm drying equipment is continuing. The only thing that stands in the way of its more universal use is the cost. The demand for mechanical drying increases as farming becomes more mechanized, as available farm labor supply decreases, and as farming methods develop and more nearly become controlled processes. Existing types of equipment can handle any grain drying problem that might arise but they can be used only if they result in a net reduction in production costs.

Grain-drying equipment is becoming more and more the result of design as drying principles are becoming better understood. The application of such equipment and its integration with other farm operations are to a lesser degree based on design principles. Better understanding of the principles involved in applying drying equipment as well as in designing it appear to be most important for future development of farm drying.

GOLDEN ANNIVERSARY FEATURE:

High Lights in the Development of the Combine

Chris Nyberg
Member ASAE

THE combined harvester thresher, or better known today as the combine, may be defined as a machine that cuts or strips the heads from the grain, and threshes and cleans the grain. Usually it is considered as a recent development, especially the self-propelled version. However, it is nearly 130 years old, as the earliest patent of record on a combined harvester and thresher was taken out August 8, 1828, by Samuel Lane, of Hallowell, Maine. There is no record of his having built any machines or actually combining grain. Several other patents were granted in the 1830's, but no records were found of any development of machines as described in these patents, except the one granted to Hiram Moore and J. Hascall of Kalamazoo, Mich., June 28, 1836 (Fig. 1).

This machine attained comparative success. It had a reciprocating sickle working across fixed guard teeth, and a rippling cylinder studded with rows of small spikes, acting as a gathering reel over the sickle. The grain was carried upon an endless apron to a threshing cylinder. Back of the threshing cylinder was a traveling sieve, or riddle, which carried the coarser refuse over to fall upon the ground. The threshed grain and chaff, sifting through the sieve, were winnowed by a fan blast, then elevated and delivered through a spout into bags.

According to historians, the Moore and Hascall machine was actually tried near Flowerfield, Mich., in 1835. On July 12, 1838, this machine, pulled by 20 horses, and cutting a 15-ft swath, harvested a 30-acre field near Climax, Mich. A later machine built by Hiram Moore was shipped to California, via Cape Horn, in 1853. It harvested 800 acres of wheat during the 1854 threshing season before it burned in the field, set afire by an overheated bearing.

It was generally considered that the climatic conditions east of the Rocky Mountains were not favorable to the use of the combine, so early development took place in the western states, especially California. There were, however, some patents taken out in various other parts of the country, but none of them seemingly developed into a practical machine.

Early models were pulled by horses (Fig. 2), and the mechanism driven by a bullwheel, hence the term "ground driven." In the 1880's a steam engine was added to supply the power for driving the mechanism, but by 1912 it was supplanted by the internal combustion engine.

In 1887, a Mr. Berry, who farmed 4,000 acres of wheatland in Tulare County, Calif., built a 22-ft cut steam-driven self-propelled combine (Fig. 3). It required a crew of six men to operate this machine, as compared to one man on today's combine. They were the fireman, steersman, header, tender, sack sewer, and water hauler. It took another man with a team to gather up the sacks and pile them into stacks in the field. With such a crew, 50 acres could be harvested in a day. In 1888, Mr. Berry rebuilt the machine and put a 40-ft header on it, and in that season averaged 92 acres a day with the same sized crew as used in 1887.

Daniel Best of San Leandro, Calif., built one of the earliest, if not the first combine equipped with an auxiliary engine to furnish power for the threshing unit. It was described in the *Pacific Rural Press,* August 24, 1889, as follows: "The chief components of the combine machine are two — the traction engine which gives the locomotion, and the harvester which has the cutting and cleaning machinery, operated by an auxiliary engine, which takes its steam by means of a flexible pipe from the boiler of the traction engine."

During the 1890's and up to about 1912, a number of machines were built using auxiliary steam engines mounted

Paper prepared expressly as a Golden Anniversary feature for AGRICULTURAL ENGINEERING.

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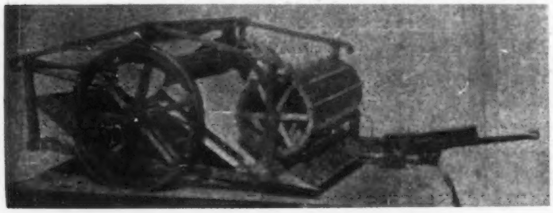
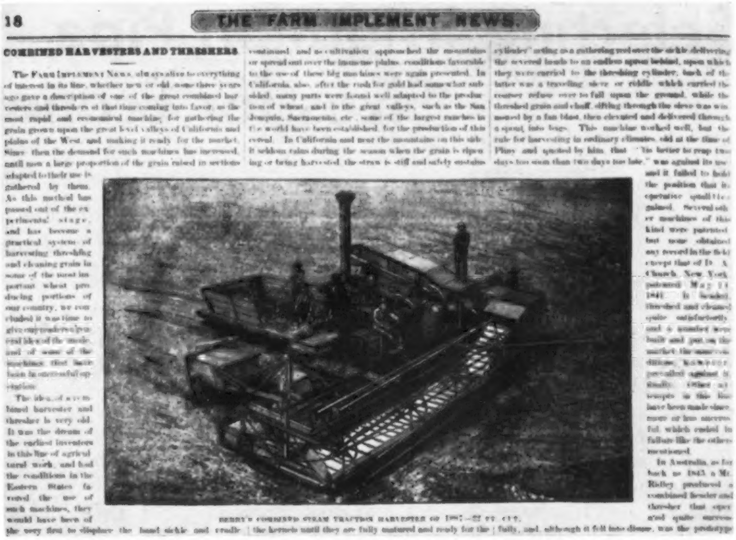


Fig. 1 *(Above)* A model of Hiram Moore's harvester, for which patents had been obtained in 1836

Fig. 2 *(Right)* Early combine models were horse-drawn. Shown is an early Holt machine


18 THE FARM IMPLEMENT NEWS.

COMBINED HARVESTERS AND THRESHERS

Fig. 3 The September issue, 1888, *The Farm Implement News,* carried a story on combined harvesters and threshers, which included this illustration of "Berry's combined steam traction harvester of 1887 — 22-ft cut"

on the combine to supply power for operating the cutting and threshing mechanism, thus insuring constant combine speed, regardless of the speed of forward travel — a thing that has proven to be very essential to successful combine operation. By 1912, the internal combustion engine began slowly to replace the steam engine, both as a means of operating the combine and for propulsion.

Hillside Combines

A statement made by a Mr. C. C. Johnson, describes early development of the combine for use in the hilly lands, "The first successful combine harvester was produced in California in the early 1870's, although the idea of this method had been growing from earlier times. In 1890 several machines were ready, which were adaptable to the plains areas of California. These were not satisfactory for eastern Washington where many hillsides were as steep as 60 percent. It was necessary to build the machine differently, and to level it to operate successfully under these conditions. The principal characteristics of these machines were the extensive use of 'raddle rakes' in the separating part of the machines, with a liberal number of fans to help move the straw, and the leveling device."

The early hillside machines were ground driven. Fig. 4 shows an early Rumely. Horses did, however, survive much longer as a means of propulsion, than they did on the level land or prairie type, since the only tractor capable of pulling the machine on the steep grades in the lava ash soil was the track-type. Machines were still being built in the late 1920's equipped with horse hitches.

The use of combines east of the Rocky Mountains did not gain much momentum until World War I and shortly thereafter, when practically all of the major threshing machine manufacturers developed combines of their own. These machines were all of the rather large sizes, having headers with 12 to 24-ft cuts, and all using auxiliary engines to operate the cutting and threshing mechanism. Most of those machines were sold in the great Wheat Belt stretching from Texas through Oklahoma, Kansas, Colorado, Nebraska and the Dakota's on into Canada.

In the mid-1930's, tractors with power take-offs appeared on the market, and small PTO-operated combines became popular. This extended the use of combines to practically all sections of the country where small grains are grown. The first were primarily wheat machines, but today they are capable of handling any kind of grain and seed grown.

Self-Propelled Combines

From 1887 when Mr. Berry built his self-propelled machine, up until the late 1930's, not much progress was made in building this kind of machine, although experimental work was done in several places. Curt Baldwin had

(Continued on page 535)

Fig. 4 The Rumely No. 3 Hillside was designed to level and cut successfully on a 40-percent grade with the header uphill

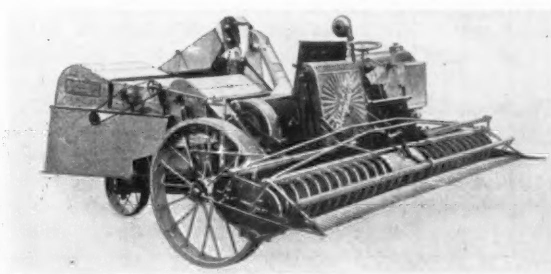


Fig. 5 The Sunshine Auto Header Harvester was developed in Australia and made its first appearance in America in 1924

Selecting Irrigation Pipe Sizes for Economy

Warren E. Howland

Methods for selecting irrigation pipe sizes in terms of head loss and cost of installation are presented and compared in an actual field example

TWO methods are presented for determining the most economical combination of lengths and standard sizes for a pipe to irrigate a narrow strip of field of a given length at a given rate of discharge per unit length of pipe and at a given total head loss. One method judged to be sufficiently precise consists merely in fitting the various available sizes of pipe to a generalized curve of diameter for the theoretically most economical tapered pipe. This curve and its formula are included with examples of use. The second method, more precise and general, requires the plotting of curves of the friction slope, *s*, for the various available sizes of pipe along portions of the length of the line. (Values of *s* may be plotted directly from available tables.) The most economical point of change from one size of pipe to another occurs where the difference between the two appropriate *s* lines divided by the difference in the cost per foot of the corresponding pipe sizes is the same at each change in size. Examples are given to illustrate the methods.

The results of the use of these methods in terms of head loss and cost for a particular installation are summarized. It is found that a pipe designed by this method consisting of three separate sizes, 6, 4, and 3-in, is almost as economical as one similarly designed consisting of diameters 6, 5, 4, 3, 2½ and 2 in. in size and indeed nearly as economical as the theoretically most economical tapered pipe; but is significantly cheaper than a two size pipe line especially when that line is designed according to a recommended method and much cheaper than a pipe of single size.

Finally, consideration is given to the very great economies in cost of pipe that could be effected if the designer were allowed to depart from the limitation of a 20 percent variation in pressure along the pipe. A *simple* method for spacing of points of discharge is presented that yields almost uniform theoretical distribution along the pipe per unit length of pipe. Examples are given for both a 20 percent and for a 40 percent variation of pressure. This method of design has been used and tested experimentally by the author as applied to a filter lateral and the results have been published.

Whether or not there is practical merit in the idea of varying spacing of points of discharge for theoretically perfect distribution of flow along a line of mildly or widely varying pressure others must decide. All that is claimed for the method of design is that it is scientifically sound and easy to apply.

Paper presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1955, on a program arranged by the Soil and Water Division.

The author—WARREN E. HOWLAND—is professor of sanitary engineering at Purdue University, Lafayette, Ind.

Acknowledgment: The author wishes to express his appreciation to Fred M. Graham of South Whitley, Ind., for the illustrative problem used throughout this paper, and John R. Davis for the cost data.

The method of design used herein is one which the author has already used in sewer design (1)* whose basic idea came from the design of the Colorado River aqueduct (2). The section of this paper dealing with the spacing of points of discharge is the direct application of the author's methods of filter pipe design—a case of distributed flow in which the author has experimentally checked the equations he employs for head loss as well as the methods of spacing set forth in this paper. (3) The author will furnish, upon request, a mimeograph statement of a derivation of the formulas used in this paper as well as an estimate of error and further considerations of costs—until the supply is exhausted.

*Numbers in parentheses refer to the appended references.

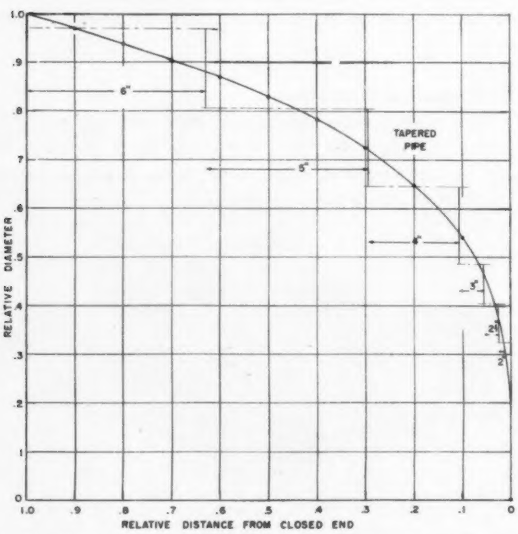


Fig. 1 "Approximate" method for design of sprinkler pipe

First Method

The first is preferred but is only an approximate method of determining the most economic lengths of different standard sizes of pipes along a pipe line discharging uniformly along its length.

In its use the following data must be known: *(a)* the flow into the pipe, *(b)* the length of the field to be irrigated, *(c)* the total head loss in the pipe and *(d)* roughness (or smoothness) factor of the pipes. The procedure is explained in the following steps.

Step. 1. Find the diameter of an hypothetical pipe of the same length as that of the field, of the same roughness as the pipes to be used, of the same total head loss and of the same entering flow but this flow to remain constant

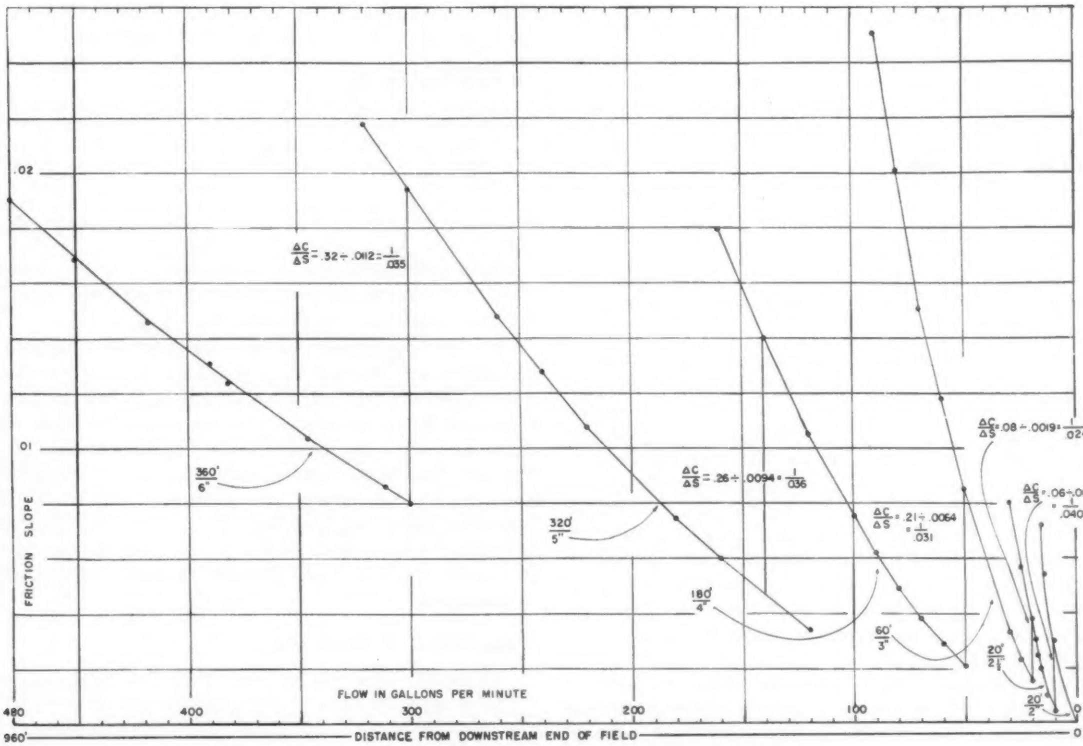


Fig. 2 "Exact" method for economic design of sprinkler pipes

throughout the length of the pipe. (This diameter may be found by the use either of available nomograms or by formulas.) Multiply this diameter by 0.915 and the result will be the maximum diameter of an hypothetical tapered pipe of most economic design. One would get the same result by first finding the diameter of a pipe of the same length as that of the field, of the same roughness factor to carry the same flow distributed uniformly along the pipe and then multiplying this diameter by 1.135. Chart 8 (4)* is the kind of chart that would make this operation convenient.

Step II. Now choose the nearest and the two or more next-smaller standard sized pipes and compute the ratios of these diameters to the maximum diameter of hypothetical most-economic tapered pipe computed in Step I. These ratios will be called r_1, r_2, r_3, etc. corresponding to the ratios of the first, second, third, etc. diameters to the maximum diameter of tapered pipe. Plot these ratios on the curve in Fig. 1. Then choose the length of the standard sizes of pipe to fit this curve as shown. A best fit seems to occur where the curve cuts the "riser" of the step at the mid-point.

An alternative numerical method makes it unnecessary to plot these values on the curve. Advantage may be taken of the observation just referred to and the equation of the curve which is $x/L=r^{2.72}$ [1] where x is the distance from the closed end of the hypothetical tapered pipe and L is its total length. Replace r by the average of first ratios, r_1 and r_2, ie. $(r_1+r_2)/2$, then by $(r_2+r_3)/2$, etc. in this equation and solve for the values of x. These distances will then locate the places where it is best to change from one standard size of pipe to the other.

If desired a check of the head loss may be made by the procedure described in the next section of this paper.

Example:

The total inflow into a field, 960 ft long, is 480 g.p.m. or 1.071 cfs to be distributed uniformly along the pipe,—10 g.p.m. every 20 ft. Use C in the Hazen Williams' formula as 130. The total head loss is to be 10 ft.

The diameter of a single pipe needed to carry this constant flow the entire length of the pipe is 6.80 in. as may be determined from an appropriate nomogram. Or it may be computed as follows:

The Hazen Williams formula for this case becomes

$$s=(Q/56.1)^{1.85}\, y^{-4.87} \qquad [2]$$

where s=friction slope, a dimensionless quantity

Q=flow in cfs.

y=diameter in ft

Here $s=10/960$ and $Q=1.071$ cfs so $y=0.567$ ft or 6.80 in.

Therefore the maximum diameter of the hypothetical most economic tapered pipe is 6.80 x 0.915=6.21 in.

An alternate method as mentioned above is to determine first the diameter of a pipe that would give a uniformly distributed flow of this amount at this head loss (which can be shown to be 5.47 in.) and to multiply this by 1.133 also giving 6.21 in.

The ratios of the standard sized pipes of nearest and next smaller size then become 6:6.21=0.969; 5:6.21=0.806; 4:6.21=0.645; 3:6.21=0.483; 2½:6.21=0.403; 2:6.21=0.322. The lengths of these pipes respectively are then as read from the curve of Fig. 1: 6—0.370×960=355 ft; 5—0.340×960=326 ft; 4—0.180×960=173 ft; 3—0.060×960=57.5 ft; 2½—0.030×960=29 ft; 2—0.02×960=19 ft. These have been rounded off to get multiples of 20 ft to 360, 320, 180, 60, 20 and 20. The

last length may be shortened to 10 ft since it is not necessary to extend the pipe beyond the last point of discharge.

If the formulas $x=L[(r_a+r_b)/2]^{3.72}$ or $L[(r_b+r_c)/2]^{3.72}$ etc. [3] are used instead of the curve, then the actual lengths become: 348, 320, 176, 67, 27, 22 which when rounded off to the nearest multiple of 20 become the same as before.

The Second Method

The second is a precise method for determining the most economical point along a sprinkler pipe line to shift from one pipe size to another.

Step I. Compute the flows along the pipe line from one end to the other showing where the actual values of flow occur which appear in available tables for convenience in subsequent plotting. The assumption on which this computation is based is that the flow varies uniformly from the entrance to the pipe to the downstream edge of the field. Then plot directly from available hydraulic tables the value of s for the several sizes of pipe along the portion of the line where it is thought that that size might be used as shown on Fig. 2. (A solution of this problem by the first method would show where the various sizes will probably be used but such a solution is not required.)

Step II. Make a guess as to where the first change in size will take place. (Here, again, the first method would help to make a most intelligent guess.) Then locate the other changes in size so that at each junction of pipe of adjacent sizes the difference in unit costs of these two pipes ΔC, divided by the difference in friction slopes, ΔS, in these two pipes at this point on the pipe line will be the same as at the first junction; in other words $\Delta C/\Delta S$ will be the same at each junction.

Step III. In order to be certain that the total head loss in this tentative design of pipe line is the same as desired this head loss should be computed. This may be done by a numerical procedure described in the next section or by measuring the appropriate area under the s-curves as on Fig. 2. If the total head loss so determined proves to be more than is desired then the shifts in size should be made farther down stream giving more of the larger size of pipe.

By noting that the desired decrease in head loss must be equal to the decease in area under the s-curves a close approximation may be made of the needed shift so that on a second trial the correct head loss will have been obtained. But if use is made of the approximate solution, the correct solution will probably be obtained in the first trial.

Example (See Fig. 2):

Here the s-lines have been plotted and the points of shift in size have been made where values of $\triangle C/\triangle S$ as defined are approximately the same. These values are, in order, for the shift from 6 to 5—1/0.035; of 5 to 4—1/0.036; of 4 to 3—1/0.031; of 3 to 2½—1/0.024; of 2½ 2—1/0.040. (The values of $\triangle C/\triangle S$ of 1/0.024 and 1/0.040, somewhat different from the others were dictated by the necessity of keeping the pipe lengths multiples of 20 ft.)

Since the lengths have been rounded off to the nearest 20 ft, the solution of the problem by these two methods does not appear to differ in results.

It must be admitted that these methods are based upon the assumption that the same discharge occurs from each 20-ft length of pipe which probably is not always the case. Relatively larger discharges probably occur near the entrance because of the larger pressures in this section of the pipe and the use of equal spacing of nozzles. This error has the effect of making the computed total head loss larger than the actual head loss. If, as is suggested later in this paper, the points of discharge are spaced to give uniformity of discharge along the pipe then this error would be eliminated.

Computation of Head Losses

Check the head losses by the following method:

- Compute the flow at the upstream end of each section of pipe by noting that it is directly proportional to the distance between that point and the downstream end of the field.
- Using appropriate tables, compute the head loss that would occur in the section of pipe of largest diameter if the flow at the upstream end of that section continued a constant and if that section of pipe extended to the downstream end of the field. Then compute the head loss in this hypothetical extension of the larger diameter pipe if its flow were the actual flow at the downstream end of the larger section (or upstream end of the next smaller section) if it continued undiminished in a pipe of the largest size extending to the downstream end of the field. The difference between these two head losses divided by 2.85 is the head loss in the section of largest diameter. Compute the head loss in the intermediate sections in the same manner. The head loss in the

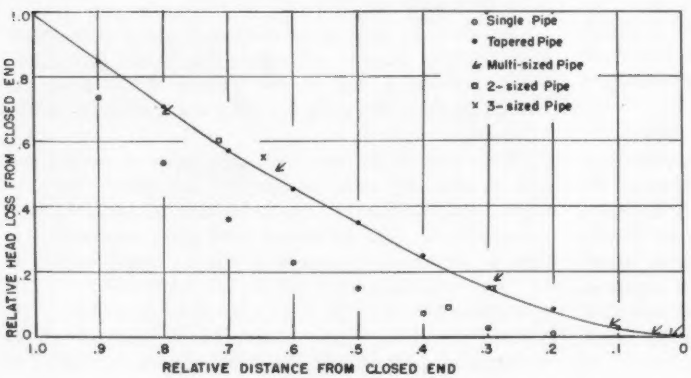


Fig. 3 Head loss from closed end in a sprinkler pipe

downstream section is simply 1/2.85 times the head loss in that pipe if the known flow at its upper end continued undiminished from its upper end to the downstream end of the field. The total head loss in all these sections of the pipe is their arithmetic sum.

(This method of estimating head loss appears to be essentially the same as that given in reference 4, p. 11.)

Example of Calculation of Head Loss

The distances from the upper end of each pipe section to the downstream end of the field are respectively: 960, 600, 280, 100, 40, 20 ft. The corresponding flows are proportional to these lengths and are: 480, 300, 140, 50, 20, 10 g.p.m. The values of s when $C=130$ read directly from Hazen Williams Tables are:

for the 6-in pipe 0.0190 at 480 g.p.m. and 0.0080 at 300 g.p.m.
for the 5-in. pipe 0.0194 at 300 g.p.m. and 0.00471 at 140 g.p.m.
for the 4-in. pipe 0.0140 at 140 g.p.m. and 0.00208 at 50 g.p.m.
for the 3-in. pipe 0.0085 at 50 g.p.m. and 0.00155 at 20 g.p.m.
for the 2½-in. pipe 0.0038 at 20 g.p.m. and 0.0010 at 10 g.p.m.
for the 2-in pipe 0.0031 at 10 g.p.m.

Consequently, using the methods described on the preceding page the head losses are:

In the 6-in. pipe	$(0.0190\times 960-0.0080\times 600)/2.85=4.70$
In the 5-in. pipe	$(0.0194\times 600-0.00471\times 280)/2.85=3.63$
In the 4-in. pipe	$(0.0140\times 280-0.00208\times 100)/2.85=1.30$
In the 3-in pipe	$(0.0085\times 100-0.00155\times 40)/2.85=0.28$
In the 2½-in pipe	$(0.0038\times 40-0.0010\times 20)/2.85=0.13$
In the 2-in. pipe	$(0.0031\times 20)/2.85=0.02$
Total head loss	9.98 ft

Comparison of Costs of Different Pipe Designs

TABLE I. SUMMARY OF COSTS OF DIFFERENT DESIGNS

	Head loss	Cost Dollars	Cost Percent
950 ft of 6-in pipe	6.43 ft	$1375.	+26%
480 ft of 6-in. and 470 ft of 5 in.	7.70 ft	1227.	+12
320 ft of 6-in. 320 of 5; 310 of 4	10.55 ft	1096.	+0.1
950 ft long theoretical pipe, 5.47 in.	10 ft	1207.	+10
260 ft of 6-in; 690 of 5	10 ft	1157.	+5.7
340 ft of 6-in; 340 of 5, 270 of 4	10 ft	1109.	+1.3
360 ft of 6-in; 320 of 5; 180 of 4; 60 of 3; 20 of 2½; 10 of 2	10 ft	1095.	0
Theoretical pipe of varying diameter	10 ft	1080.	−1.4

From Table 1 it appears that for a 10-ft head loss the pipe designed according to the methods set forth in this paper which ranges in size from 6 to 2 in. is nearly as economical as the theoretically most economical tapered pipe which costs only 1.4 percent less, that the pipe designed according to these methods but ranging in size only from 6 through 5 to 4 is nearly as economical costing only 1.3 percent more. The two size pipe designed according to these methods costs 5.7 percent more but when designed according to a method recommended in reference 4 costs 12 percent more. This design, however, cuts down on the head loss. The single pipe 5.47 in. in diameter if available would cost 10 percent more and the single pipe that is available would cost 26 percent more though the head loss would be reduced.

Thus it would appear from this example that the use of the design methods just set forth in this paper would result in real though modest savings in cost of sprinkler pipes.

Spacing of Points of Discharge Along Sprinkler Pipes

A greater opportunity for economy of design of sprinkler pipe systems appears to lie in the use of the techniques about to be described for continuously varying the spacing

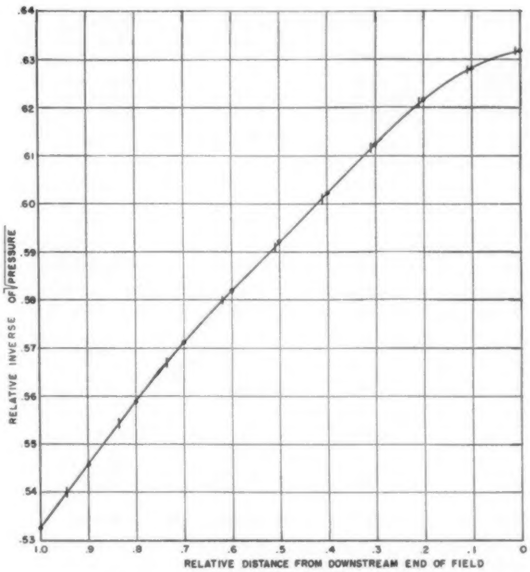


Fig. 4 Spacing for 40 percent variation in pressure

of the points of discharge along the pipe line to effect a theoretically perfect uniformity of discharge along the pipe in terms of rate of discharge per unit length of pipe for any degree of variation of pressure.

This method has been published by the author[3] but only as it applies to a filter lateral where the pressure increases in the direction of flow due to the importance of what is called velocity head recovery in these pipes and the relative unimportance in them of friction losses.

The method is based on the determination of the relative pressures—in any convenient unit—at equally spaced points along the entire pipe line.

On Fig. 3 have been plotted the relative head losses for the various designs of the pipe considered above. It may be seen that the distribution of head loss is substantially the same for the tapered pipe, the multisized pipe and for the three-sized pipe. In the example to be given the pressures and head losses for the tapered pipe are used but it is evident that the results would be substantially the same for the others. (11 points at the extremities of 10 equal spaces have been chosen in the illustrative examples shown in Table 2.) The square roots of these 11 relative pressures were obtained and then the reciprocals of these square roots are plotted along a representation of the pipe as shown in Fig. 4.

Finally the area under this curve of the inverse of square roots of pressures is computed by assuming it to be ten trapezoids. The problem is now to divide this area into as many vertical strips of equal area as there are points of discharge. The width of each strip is the space tributary to each nozzle and the nozzle will be placed at the center of each space. If A is the total area and n is the number of spaces the area of each small vertical strip is A/n and the width of this area, Δx, is equal to (A/n) divided by the ordinate of the curve.

Starting at the downstream end of the field the width of the first strip is computed by dividing the area of one of the equal area strips by the end ordinate of the curve. (The

TABLE 2. DESIGN OF SPACING FOR A TAPERED, MULTI-SIZED OR THREE-SIZED PIPE IN WHICH THE PRESSURE VARIATION IS 40 PERCENT OF THE PRESSURE AT THE CLOSED END.

Relative Distance from closed end	Relative pressure variation	Relative pressure	Relative square root of pressure	Relative reciprocal of square root of pressure: Calculated	Relative reciprocal of square root of pressure: Read from curve	Relative space or 0.0123 divided by previous column	Relative distance from down-stream end
0	0	2.5	1.581	0.632/0.316†	0.632	0.0194 ×	0.5=0.0097*
						0.0195 ×	5=0.0976
0.1	0.028	2.528	1.592	0.628	0.631		0.1073
						0.0197 ×	5=0.0985
0.2	0.084	2.584	1.610	0.622	0.625		0.2058
						0.0200 ×	5=0.1000
0.3	0.157	2.657	1.632	0.612	0.616		0.3058
						0.0202 ×	5=0.1010
0.4	0.243	2.743	1.658	0.603	0.608		0.4068
						0.0206 ×	5=0.1030
0.5	0.344	2.844	1.688	0.593	0.597		0.5098
						0.0210 ×	5=0.1050
0.6	0.457	2.956	1.720	0.582	0.587		0.6148
						0.0214 ×	5=0.1070
0.7	0.577	3.077	1.752	0.570	0.575		0.7218
						0.0219 ×	5=0.1095
0.8	0.709	3.209	1.790	0.559	0.562		0.8313
						0.0225 ×	5=0.1125
0.9	0.850	3.350	1.832	0.546	0.548		0.9438
						0.0229 ×	2.5=0.0562
1.0	1.000	3.500	1.875	0.533/0.267†	0.537		
Total (using ½ end values)†				5.898			48=10.000
Now 5.898/48=0.0123				Area=0.5898			
One-half of 0.0123=0.00615							
0.00615/0.631=0.0097*							

NOTE: Using the figures given in the next to last column the actual spaces come out to be 0.00967 × 960=9.3 ft i.e. the first nozzle should be 9.3 ft upstream from the downstream end of the field and the pipe may be cut off at this point making it 950.7 ft long. The next 5 spaces between nozzles will be 0.0195 × 960=18.7 ft each; the next 5—0.0197 × 960=18.9 ft each; the next 5—19.2; 19.4, 19.8, 20.1, 20.5, 21.0, 21.6, the last 2 spaces will be 21.9 ft and this will be 0.0229 × ½ × 960=11.0 ft from the entrance to the pipe. It will be found that these distances add up precisely to 960.1 ft. If the pressure variation were only 20 percent of the pressure at the closed end then the spaces in this pipe would be: 9.6; 5 at 19.2, 19.4, 19.6, 19.7, 19.9, 20.1, 20.3 20.6, 20.8; 2 at 21.0 and finally 10.5 total 960.1 ft.

. . . Selecting Irrigation Pipe

curve is flat in this region.) Then, estimating where on the curve the middle of the next strip will be, one reads the ordinate at this point and similarly computes the width of the next strip—adjusting if necessary the value of the ordinate if the one that was read did not occur at the middle of the strip. (In the example given no such adjustments were found to be necessary.) In this way one proceeds down the pipe computing one space after another or—one group of spaces after another. (In the example given 5 spaces are computed at a time.) The method almost guarantees that exactly the correct number of spaces will result and no fraction left over as shown by the example.

Note that the distance from the downstream end of the field to the first nozzle is one-half space and that the pipe in the downstream end of the field does not need to extend past the last nozzle.

In the two examples worked out in the accompanying Table 2 after the first one-half space was computed at the end of the pipe the other spaces were grouped into fives and the total width of the group was computed as though it were a single space. Since there were to be 48 spaces in all there remain 2½ spaces after ½ plus 9 groups of 5 each were found.

Table 2 shows the computation of spaces for a level line in which the loss in pressure throughout the pipe is 40 percent of the downstream or minimum pressure in the pipe.

Also the spaces for a line in which the head loss is 20 percent of the minimum pressure are given at the bottom of this table. The second case is close to what is recommended for sprinkler pipes—the first has nearly twice the recommended head loss. In each case the theoretical uniformity of distribution of flow along the length of the pipe is practically perfect but the first cost (not operating cost) of the first pipe would be 16 percent less than that of the second. If low pressures on the downstream nozzles were not considered objectionable because of lessened lateral reach of the spray then the operating costs need not be different in these two designs. The lateral reach is roughly proportional to pressure.

It is assumed in these cases that all nozzles have the same hydraulic characteristics. If the size of the openings in the nozzle could be adjusted in small increments then uniformity of discharge could be effected without varying the spacing.

Whether or not it is desirable to vary the pressure in the pipe beyond the recommended limitation of 20 percent, there appears to be a clear advantage in utilizing some such method as the one described in this paper to vary the spacings or size of openings to effect the theoretically perfect distribution along the pipe which the method makes possible.

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2 Howland, W. E. Finding the low point on the cost curve. *Journal of American Water Works Association,* Vol. 39, p. 632. July, 1957.

3 Howland, W. E. Design of perforated pipes for uniformity of discharge. Proceedings of the Third Midwestern Conference on Fluid Mechanics, University of Minnesota, p. 687, 1953.

4 Regional Engineering Handbook Part 3. Conservation irrigation, U. S. Dept. Agriculture, Soil Conservation Service, Southeastern Region, November, 1951 (a pamphlet of 42 pages plus several Appendices).

Increasing Production

An addition to the checker board fleet of portable feed mills operated by the Ralston-Purina dealer organization is this diesel-powered Sedbury unit recently introduced in the Chattanooga, Tenn., area. Photo shows the new unit on its weekly job of grinding feed for 400 dairy and beef cattle on the 200-acre J. M. Gibson farm near Brainerd, Tenn. The unit grinds a mixture of grain, hay and concentrate at the rate of approximately one ton per hour.

Correction

We have been informed that the caption for the left-hand picture at the top of page 429 in the June, 1957, issue, is incorrect. Reciprocating action paddles are used to move the feed the length of the bunk, therefore the feeder should not have been reported as an auger type.

. . . Combine Developments

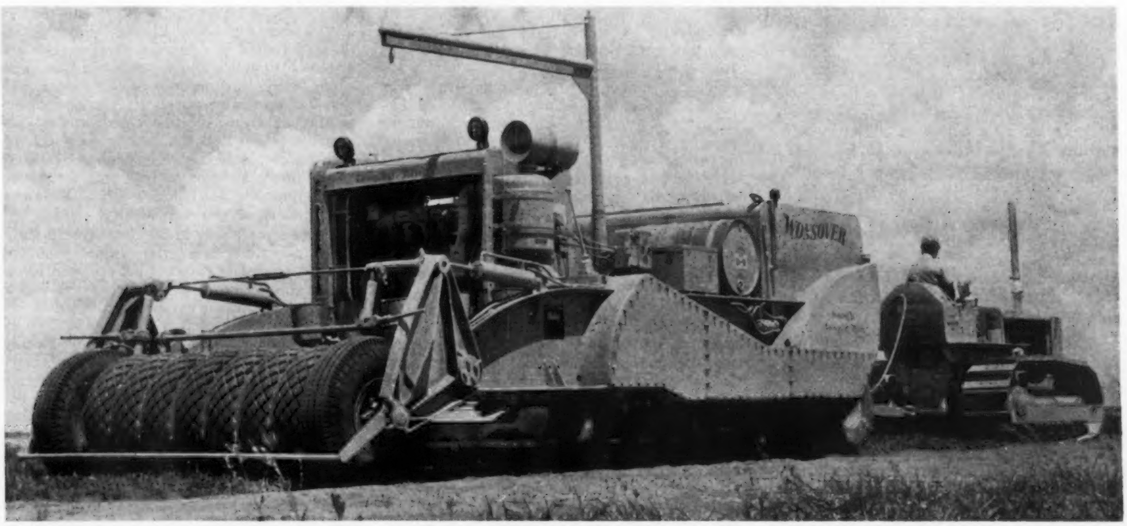
(Continued from page 529)

one in 1917, or perhaps earlier, and in 1923 in conjunction with his brothers and others, he had developed a model that mounted on a Fordson tractor.

A machine called the Sunshine Auto Header (Fig. 5) was developed in Australia and it made its first appearance in the United States and Canada in 1924. In the late 1920's some of Australian machines were actually built in Canada. They used a different method of gleaning from that used by the American-made machines, in that instead of cutting off part of the stems along with the heads, they just simply stripped the heads off. This stripping method of harvesting dates back to the first century. A reaping machine of this type was described by Pliny during the first century, as in use in the fields of Gaul. It was also mentioned by Palladius in the fourth century, which would indicate that it was in use for many years. Then it seems as though it was forgotten for many centuries.

The present type of self-propelled combine was introduced in 1938, and a number of them were sold in the United States and Canada. Sales remained rather small until 1944, when the shortage of labor caused by World War II, and the need for growing large acreages of wheat brought about a real impetus to the sales of these machines.

Mass Performer Now Mass Produced



A new multi-purpose farm machine designed to prepare and condition the soil, plant the seed and pack the earth in one operation is now being mass produced. Developed by the Norton Portland Corp. in Portland, Me., the Wonsover Model 96 will be manufactured for the Maine concern by the Houston, Texas, branch of the Todd Shipyards Corp.

The 12-ton machine is towed by a tractor. The control panel, attached to the trailing machine by an extension cord, is directly in front of the driver and provides finger-tip control of the functions of the machine by means of electrically controlled buttons. The machine will prepare a strip of land 8-ft wide.

At the front of the unit are two bins for lime and/or fertilizer and two tanks for weed killer, pest killer or liquid fertilizer. Stainless steel metering sleeves control the flow of lime and fertilizer. Behind the bins is the attrition chamber where the soil is prepared, taking the place of plowing and harrowing. A three-shaft hammermill contains 52 rotating pulvi-hammers that slice through the soil down to a depth of 10 in. The depth is adjustable by means of hydraulic cylinders which raise or lower the machine on its wheels.

The hammers are made of a special alloy steel and hit the ground at speeds over 100 mph thus crushing vegetation and obliterating small stones. Spring-loaded mountings permit the hammers to fold up and pass over large rocks. If liquid fertilizer or pest killer is used, the homogenization takes place in the attrition chamber while the soil is in suspension. Even exhaust fumes from the 300-hp diesel engine are utilized in the chamber.

Following the attrition chamber is a revolving doctor blade of hard rubber which smooths the conditioned soil. Any seeder the farmer may have can be adapted to the seeding bay to plant anything from garden truck crops, legumes, seed grains to root vegetables. The device can also be adjusted to plant broadcast or in rows. A sub-soiler, installed as optional equipment, is used to improve the distribution of moisture. Remotely controlled, it can be adjusted down to a depth of 25 in.

Seven packing wheels, whose pressure can be adjusted, pack down the soil over the seed. Tire treads have been designed in these packing wheels to leave a notched pattern on the surface to prevent erosion and retain maximum moisture. The final device at the back of the unit will apply a pre-emergence spray to kill weeds or insects that might be blown onto the newly-planted soil. To further combine farming operations the new machine conceivably can be attached to the rear of a harvester and while a crop is being harvested, a new crop can be planted immediately.

This column contains letters in which our readers have expressed opinions, suggestions, unusual experiences, or divergent views on subjects of an agricultural engineering nature. It is the intention of the editor to publish a few such letters in each issue of AGRICULTURAL ENGINEERING to encourage free expressions and open debate on pertinent and timely topics.

An Appreciation of J. Brownlee Davidson

(EDITOR'S NOTE: The following letter, to the central office of the ASAE will be of special interest to the many readers who knew Dr. Davidson. The writer, E. W. Hamilton, attended the organization meeting of the Society in 1907, knew well the ASAE founding group and has long been an enthusiastic friend of the profession and the Society.)

THE current issue of *Farm Implement News* of Chicago carries the news of the passing of Dr. J. Brownlee Davidson. This comes as a real shock to me as I had no knowledge that he was in ill health.

To those of us who have enjoyed his friendship and acquaintance since the founding of the American Society of Agricultural Engineers, the meetings of the Society will never be quite the same without the presence of J. B. Davidson quietly circulating up and down the corridors or sitting in the assembly rooms at the place of meeting. His voice was scarcely to be heard above the chatter of groups of individuals attending the meetings, but somehow his presence was always a reminder that an ASAE meeting was in progress.

Dr. Davidson might well be called the "grand old man of agricultural engineering." He was one of the few who initiated the idea and did much to create a profession out of the old "farm shop practices" by which the mechanics of agriculture was designated in the agricultural college curriculums more than a half century ago.

There are only a few of us left who remember the first meting at Madison, Wisconsin, at which the ASAE was organized. William Boss, Philip S. Rose, Charles A. Ocock, and Howard W. Riley are the only ones still living that I can recall at present. There may be others whom I do not remember.

At the second meeting of the Society, held on the Iowa State campus at Ames, J. B. Davidson was a very busy man. The attendance was small and a severe Iowa blizzard held us on the campus for an extra day because all trains passing through Ames were snowbound. I recall that the small attendance required that nearly everyone attending the meeting had to appear on the program in order to round out the meeting. Frank G. Blake, then advertising manager for Deere & Company, and J. B. Bartholomew, president of the Avery Company, and myself were obliged to take an interurban car to Des Moines in order to catch the Rock Island railroad for the east. There were no bus facilities in those days.

Dr. Davidson was a quiet man. Oratory was not his forte, but his presence inspired both inspiration and confidence when the future of such a thing as "farm mechanics" was hazy and uncertain. He caught a vision of farm mechanization which very few saw in 1907. The passing of the horse and the idea of complete substitution of mechanical power on the farm was something which was doubtless unthought of by most of those who gave any serious consideration to agriculture's future, leastwise the farmers themselves.

Whether Davidson's vision was mere inspiration or something carefully reasoned out is beside the point. The fact remains that he never for a moment permitted discouragements and ridicule to swerve him from his main objective. His work as head of the department of agricultural engineering at Iowa State College proved that, like a sturdy tree, while winds may buffet the branches, J. B. was steadily producing new roots in his classroom which reached out everywhere to establish new shoots in newly established agricultural engineering classrooms throughout the country.

J. B. Davidson was a family man, a Christian, a friendly man, a professional man, and a business man whose friends and acquaintances will long remember. He was the soul of honor and integrity, with an honesty of purpose which would not be denied. I remember in particular an incident which happened at Winnipeg, Canada, one year during the Winnipeg Motor Competition.

The Winnipeg motor contests began in 1908, the first one being limited largely to plowing with steam traction engines. The judges were mostly steam engine men secured from the shops of the Canadian Northern and Canadian Pacific railways in Winnipeg. By 1910 these contests were almost completely dominated by gas tractors. Manufacturers in the then rapidly growing gas tractor industry were eagerly participating in these contests, and the problem was to secure competent judges who had some knowledge of internal-combustion engines and gas tractor power as applied to agriculture.

The Winnipeg Motor Competition was sponsored by the Winnipeg Industrial Exhibition Association, and at a preliminary meeting in May, 1910, the question of where to secure judges came up. I attended that meeting and volunteered the suggestion that it might be possible to secure judges from the agricultural engineering departments of the agricultural colleges in the United States and Canada. Inasmuch as a suggestion sometimes invites responsibility, I was given the task of looking into the matter to see what could be done.

I wrote J. B. Davidson and told him what we had in mind and in his reply he enthusiastically endorsed the idea. The result was that such agricultural engineers as L. W. Chase, M. L. King, H. W. Riley, H. H. Musselman, L. J. Smith, A. R. Greig, W. J. Gilmore, J. B. Davidson, I. W. Dickerson, C. A. Ocock, W. F. MacGregor, G. B. Gunlogson, and others, along with several agricultural engineering students from the colleges to act as observers, came to Winnipeg during the motor contests to supervise the testing, record data, and judge the plowing and brake tests of the various gas tractors and steam traction engines entered from the United States, Canada, England, Germany, Italy and Sweden.

Tractor and plow company executives, bankers, agricultural college presidents, oil company officials, bonanza farmers, newspaper editors and reporters, and crowds of sightseers made quite a sizable gathering at these events, to witness in fact the birth of the new era of "power farming."

Manitoba weather can be both hot and windy during the long sunny days of mid-July, and I can still see J. B. Davidson as he carefully measured the oil and coal for the competing machines, inspecting each machine for some hidden gadget which an unscrupulous contestant might have hidden in the gas tank, boiler, or elsewhere, in order to gain some slight advantage over competitors, carefully checking dynamometers and tachometers, with the perspiration streaming down his face under a "haymaker" straw hat tied under his chin with a green string to keep the wind from ballooning it across the Manitoba prairie.

Hours were long and the work was hard for both the judging crew and the contestants, but at last the final furrow would be turned and the tractors, steam engines and plows would be given careful final observation checks. Then would come the task of deciphering and compiling the mass of data taken by the judges and observers down to the last word, figure and decimal point.

At the 1911 motor competition, J. B. Davidson was in charge of the judges who went to work at the completion of the testing in a large closed room in the Royal Alexandria Hotel in Winnipeg. The room was furnished with quite an array of tables, blank paper, adding machines, slide rules, and other paraphernalia necessary for the job at hand. The judges began work at 2 p.m. and the lobby of the hotel was filled with anxious tractor officials, factory engineers, representatives of the press, and others interested in the final results. At 3 a.m. the following morning, Davidson came out of the elevator at the hotel and handed A. W. Bell, manager of the Winnipeg Industrial Exhibition Assn., several typewritten sheets of paper which contained the complete figures and findings of the judges. All was eager excitment. Both joy and disappointment could be discerned among the crowd as Mr. Bell finished reading the results. Telephone and telegraph wires were soon busy as the news was broadcast throughout the world. The 1911 Winnipeg Motor Competition was history.

I went home and to bed but arose a short time thereafter, and after a glance at my mail at the office, I went back to the Royal Alexandria Hotel. As I entered the lobby, which was practically deserted so early in the morning, the first man I met was J. B. Davidson, who was disconsolately staring into space with a face as long as a hungry anteater. He scarcely responded as I greeted him, and I said, "What is wrong, J. B.? You look as if you had lost your last friend." He did not reply for a minute or two, and when he did, he said, "Hamilton, something terrible has happened and I do not know what to do about it. A bad mistake has been made and I can think of no way to correct it."

What had happened was that in compiling the mass of data, a decimal point had been misplaced, which threw a contestant in one class from first to second place. That same contestant, however, had succeeded in winning five other firsts in other classes, but the misplacing of that decimal point had robbed him of another first. It was purely a clerical error, but how to correct it was the problem, when all the results had been scattered far and wide over the wires and were now public property.

I had no immediate solution and so remained silent. Impatiently, J. B. said, "Tell me what to do. Something must be done at

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Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. Information concerning copies of these papers may be obtained by writing to the American Society of Agricultural Engineers, St. Joseph, Mich.

Paved Inverts of Open Channels, by McLemore Roberts, DPWO, Sixth Naval District, Charleston, S. C. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a special program arranged by the Soil and Water Division for Public Lands and Public Works. Paper No. **PL-30.**

This paper deals with channels used for disposal of storm runoff from relatively small watersheds, and/or seepage or other constant trickle flows. Water supply canals and high-velocity channels handling supercritical flows are not included. Information was gathered in four southeastern states, with observations along state and county highways, in national parks, and on Naval establishments. The writer developed curves and diagrams for evaluating buoyancy and shows how adequate weep-holes can prevent uplift by groundwater.

The author states that it is not always necessary that a paved invert extend all the way up the sides of a channel to the maximum depth of flow, if good sod is maintained above the rim. Velocity in a stream is slowest in the shallow water at the edge. The pavement can stop where the velocity is safe for sod to carry. In channels of flat gradient and sluggish flow, this may be only a few inches from the bottom. On steep gradients high velocities may continue to the surface.

Seed Cleaning and Handling, by J. E. Hammond, agricultural engineer (AERD, ARS), USDA, Oregon State College, Corvallis. Paper presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Joint Farm Structures and Rural Electric Divisions. Paper No. **57-34.**

This paper points out that the production of grass and legume seed in the United States in 1942 exceeded 200 million dollars and their imports another 15 million dollars. In order to meet the quality standard, equipment manufacturers have been developing precision equipment for making separations to minimize loss in handling and cleaning the seed. The seed loss continues to exceed the quantity of seed marketed. The problem of seed separation is hard to solve because of the variation of seed size, which is influenced by growth factors such as weather conditions, soil fertility, drainage, and other environmental factors.

The USDA and the Oregon Agricultural Experiment Station have started a research project on farm seed cleaning and handling because of the importance of the seed loss. Seed laws are becoming tighter and purity of varieties are more important therefore, the author states that it is urgent that improved methods of handling be developed.

Hydrologic Techniques in Watershed Planning, by H. O. Ogrosky, hydrologist, SCS, USDA, Washington, D.C. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a program arranged by the Soil and Water Division. Paper No. **57-96.**

This paper outlines the general approach used by the Soil Conservation Service in the hydrologic studies of small watersheds. Some of the reasons for the use of this approach are given, and an example is presented to illustrate the method used in determining runoff from watersheds. A plotting of rainfall data against computed and observed runoff data is used to illustrate the results obtained by using Soil Conservation Service methods.

Wagon Drying of Baled Hay, by William J. Roberts, research asst. in agricultural engineering, Rutgers University, New Brunswick, N. J. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a program arranged by the Farm Structures Division. Paper No. **57-72.**

The author points out that weather, scheduling of farm operations, and the severity of modern hay handling calls for the harvesting of forage for top quality at a moisture content above the recommended safe storage level. When forage is harvested in this manner, artificial drying is used. Wagon drying implies that the wagon must be able to perform as a rugged farm wagon as well as a good drying chamber.

The paper explains that structures used to house the wagons and the ductwork, range from converted farm buildings to new pole-type structures. In most wagon drying installations attempts are made to incorporate recirculation features into the design of the system. Work is being done in adapting temperature control devices to control the drying process and recirculation.

Water Requirements for Cotton, by Eldon G. Hanson, head, agricultural engineering dept., New Mexico A & M College. Paper presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Soil and Water Division as a part of a symposium on irrigation water requirements. Paper No. **57-35.**

During the past decade the water supply for most of New Mexico has been below normal and in irrigated areas the water is wasted because of improper use. Therefore it has been considered necessary that research be continued to determine the best practices for efficient distribution on the farm and the desirable frequency or time of irrigation for different soil types. A chart showing the allotments of water available for delivery to the land during the past few years is included. This chart shows the impact of the drought conditions along the Rio Grande River.

The present research program reportedly has produced valuable information showing the influence of different amounts of water on cotton yields. It emphasizes the importance of good land preparation as a means for obtaining maximum crop production with the minimum amount of irrigation water.

Planning and Planting for Sound Abatement, by Wilbur H. Simonson, Office of Engineering, Bureau of Public Roads, Washington, D.C. Paper presented at Golden Anniversary Meeting in East Lansing, Mich., June, 1957, on a special program arranged by the Soil and Water Division for Public Lands and Public Works. Paper No. **PL-9.**

Noise from home appliances, office machines, jet planes, and from continuous streams of heavy trucks, busses, and automobiles will increase between now and 1975, in proportion to the increase of industrial and public works programs, according to this paper. Emphasis here is on noise which emanates from the highway to the surrounding area, as well as with what may be done by the highway engineer to make this noise less objectionable to roadside dwellers. The author includes three aspects of sound abatement — design and improvement of vehicles to produce quieter vehicles, enforcement of ordinances and regulations to keep noise to a minimum, and care in the location and design of new highways.

This presentation directs attention to certain acoustical terms used to measure sound, and to certain instruments for the measurement, evaluation, and correlation of truck noise with the human ear. Reports previously published are cited and a list of references is included.

. . . J. B. Davidson

(Continued from page 536)

once in fairness to the contestant." I was puzzled, but just then an idea occurred to me which at first appeared too simple even to think of, but having nothing better to offer at the time, I said, "When a judge makes a decision on the bench, it is practically irrevocable, except in the hands of a higher court, but in this case there is no higher court to which to appeal. If you change it now, the public is liable to suspect that all the results are subject to revision and might as well be thrown out." I also pointed out that the contestant had already won five firsts and should be satisfied; and, also, if the matter of the decimal point were to be opened up, it might tend to reflect on the five firsts which this contestant had won. I said that, under the circumstances, I believed he was justified in burying the error and to so instruct his judges.

J. B. Davidson's inherent honesty would scarcely permit him to accept this solution. He made no reply one way or the other, and I never heard any more about it nor did he ever mention it to me afterward. I still have the sheet upon which the misplaced decimal point appears, the point being surrounded by a blue-penciled ring. The episode has always remained with me as a reminder of the conscientious honesty of Dr. Davidson.

Several years after this occasion I discussed the matter with the manufacturer whose "first" was lost through the misplaced decimal point, and when I explained just how it happened, he had a good laugh and said that it was probably the only thing to do under the circumstances. This particular manufacturer is one of the largest builders of tractors in the United States today, and whenever I see him he usually jokes about the misplaced decimal point.

I regret that I shall not be able to attend the Golden Anniversary Meeting of ASAE at East Lansing, due to serious illness in my home.

(Signed) E. W. Hamilton

545 South Randall
Madison, Wisconsin

The 1957 ASAE Gold Medalists

Cyrus Hall McCormick Medal was awarded to Rudolph H. Driftmier

IN keeping with what has grown to be a custom, the Cyrus Hall McCormick Gold Medal for 1957 is once more awarded not for a single spectacular achievement but for a crowded career of outstanding contribution to a man's profession and to his countrymen. It embraces competent research, able administration, and above all educational leadership.

It was at Clarinda, Iowa, on March 10, 1898, that Rudolph Henry Driftmier was born the son of John F. and Mary (Handorf) Driftmier. He attended local primary and secondary schools, and for two years was a student at Grinnell (Iowa) College. Continuing at Iowa State College, he earned his bachelor's degree in agricultural engineering in 1920, and in June of that year married Helen Spry. In 1920, as he had in 1919, he served three months as assistant county engineer of Page County, Iowa.

In that year, too, he started his decade of connection with Kansas State Agricultural College, where he progressed from instructor to professor of agricultural engineering. Along the way he earned the advanced degrees of M.S. in 1926 and A.E. in 1929. His research work at Kansas State dealt largely with farm sewage disposal systems and with hay harvesting equipment.

In 1930, Mr. Driftmier became professor and head of the agricultural engineering department at the University of Georgia. In a reorganization of the College of Agriculture in 1950, he also became chairman of the division of agricultural engineering, responsible for teaching, research, and extension in the subject throughout the State of Georgia, including policies and budgets as well as program planning, direction and coordination. He continues in this two-fold primary responsibility.

He had done some research and design work in building at Kansas, and he had hardly arrived in Georgia when this talent was put to work. From 1930 to 1933, he was engineer in charge of construction and maintenance for the College of Agriculture at Athens. In 1934, he was made consultant and advisor to the rural rehabilitation division of Georgia, Emergency Relief Administration, on engineering and architectural phases of land settlement; in 1935, its engineering consultant on rural industrial organized communities.

For the period 1935-1945, Professor Driftmier was supervising engineer for the entire University System, in charge of building and facilities plans and specifications, cost estimates, supervision of construction, contractual relations and fiscal matters. In addition, 1943-45, he was head of the Department of Plant Operations, University of Georgia, in charge of just about everything.

Since 1948 he has been a member and chairman of the building committee, University System Building-Authority, a five-man board appointed to finance and construct some $40 million worth of buildings among the 16 units comprising the University System. In 1949, too, he was engineering consultant to the Economic Cooperation Administration, on a special mission to France concerned with rice, cotton and peanut production in French West Africa.

Withal his distinction in these myriad capacities, it did not hamper, nor should it obscure, his central career as a notable teacher. Among those who urged or commended his selection as the medalist are some who were moved not by personal acquaintance so much as by the caliber of engineers developed under him.

Despite stern devotion to standards of scholarship, he evoked fine personal relationships. How awe gradually grew to affection appears in his alleged appellations by advancing students, being called (in absentia) Professor Driftmier by freshmen, Mr. Driftmier by sophomores, Driftmier by juniors and Rudie by seniors. On the faculty level, among his co-workers and close associates, he is commonly called The Boss—a term with its own acquired semantics which surround rank with respect, authority with affection.

Of his myriad memberships, perhaps it should be said that Rudie is not so much a joiner as an appointee. As a boy in Iowa, he belonged to a 3-H Club and to its successor 4-H Club, claimant (among others) to the title of first to be organized in America. A veteran of World War I, with six months service in France with the 67th Coast Artillery Corps, he was a post commander of the American Legion in Kansas, a member in Georgia.

Of honor societies he belongs to Sigma Tau, Gamma Sigma Delta, Aghon, Phi Kappa Phi, and the Gridiron Club of the University. Listings include *American Men of Science, The Southerner, Who's Who in America,* and five (yes, five) other *Who's Who's*. He is an honorary Georgia Planter, an honorary member of the Atlanta Farm Equipment Club, Future Farmers of America, and is a registered professional engineer of Georgia.

As a Rotarian, Rudie served his club as director; as a Presbyterian, as elder and chairman of the board of deacons. It is said, that in token of his generosity, and whether he knows it or not, he holds unofficial "honorable" membership in every community church, regardless of denomination, established by the janitors of the campus since his arrival thereon.

As if the infinite variety of duties within the University System were not enough, Prof. Driftmier was member of the Athens Board of Education from 1948 until 1955 when the Athens and Clarke County schools were consolidated into the Clarke County school system, whereof he then was reappointed and elected president of the board. An earlier civic service was on the City Planning Commission of Manhattan, Kansas. He also serves on the board and the finance committee of the University of Georgia Athletic Association.

In the year of transition from Iowa to Kansas, 1920, Rudie joined the American Society of Agricultural Engineers. A quarter-century later, 1944-45, he was its president. Along the way, before and since, he has served as vice-president and as councilor for two terms, totaling five years. Chairmanships include: Georgia Section; Southeast Section; College Division; Jury of Awards; Committees to ARA, USDA, and Rural Housing and Farm Buildings Division of BPISAE, USDA; and Committee on Vocational Teacher Training. He also has served on committees on cooperation with Association of Land-Grant Colleges and Universites, and with the American Society for Engineering Education, as well as on the ASAE Nominating Committee.

Besides representing ASAE in the American Society for Engineering Education, he

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The American Society of Agricultural Engineers awards annually the Cyrus Hall McCormick Medal for "Exceptional and Meritorious Engineering Achievement in Agriculture" and the John Deere Medal for "Distinguished Achievement in the Application of Science and Art to the Soil." Presentations of the 1957 Awards were made during the Society's Golden Anniversary Meeting at Michigan State University, East Lansing, Mich., June 26, 1957.

The John Deere Medal was awarded to Archie A. Stone

TO a singularly literal degree the John Deere Gold Medal goes this year for "distinguished achievement in the application of science and art to the soil." It honors a career devoted largely to closing the gap between textbook and test tube, classroom and laboratory on one hand, and the everyday work with plow and power on the farm. It recognizes world renown as an educator achieved by a man who has not, or will not admit, a single academic degree.

Archie A. Stone was born July 3, 1893, at Morris, Minnesota, the son of a farm implement dealer, also named Archie A., and Theodora (Mills) Stone. He attended the Morris primary and high schools, and at 17 was himself a rural school teacher. The following year, however, he attended the University of Minnesota. Some years later he took work in the U.S. School of Military Aeronautics at the University of California (Berkeley) and at Hofstra College of New York University.

Meanwhile, for some five years he was back at Morris, in the retail implement business. In 1916, at the tender age of 23, he was elected to the Minnesota Legislature by a big majority, albeit by an eleventh-hour sticker campaign. This political career ended untimely with America's entry into World War I and his own entry into the Army Air Service in 1918.

The following year he was instructor in farm power and machinery at the Soldiers Agricultural School, Lawrenceville, New Jersey. In 1920-21, he was instructor in the same subjects at the Long Island Agricultural & Technical Institute (State University of New York) at Farmingdale, N. Y. In 1921, he became head of the department of agricultural engineering, a capacity he continued until 1942 and later it was changed to emeritus status.

A bit before this, in 1940-41, he was coordinator of a civilian pilot training program of the Civil Aeronautics Administration, conducted at his own Institute. With America's plunge into World War II, Mr. Stone, in 1942, was appointed first as technical advisor and shortly as chief of the Farm Machinery Section, Office of Price Administration, continuing as such until 1946 when he became associate agricultural relations advisor in the OPA. Of those times one of his friends says:

"There he sat, in the midst of thousands of war-time bureaucrats, all of whom were burgeoning with countless ideas of how to run this and that business. . . . The bureaucrats swarmed around him, over him, and under him, but Archie always kept his aplomb. He is a mighty hard man to excite.

"They wanted to standardize tractors. They wanted to have only one company building them. They would control everything on the farm from the size of the farmer's overalls to the design of his manure spreader. Archie, in his typical way, would cock his ear, lean back in his chair and listen to them by the hour. He had his quizzical smile always at hand, and, although he never offended a single bureaucrat, no matter how hair-brained, he stuck to his principles and kept American agriculture afloat and free of many things. . . .

"I must say, too, that Archie sometimes used the same technique on businessmen. He could simply kill you with listening. But when he made his decisions, they were fair, honest and wise."

With that war out of the way, he joined with the late J. B. Davidson and Messrs. H. F. McColly and E. L. Hansen in a mission to China, sponsored by the International Harvester Company. There, in 1947-49, Mr. Stone served as head of the department of agricultural engineering, National Central University at Nanking.

One of his friends in China, a medical officer in the Army Advisory Group, tells how the Stone quarters were constantly filled with Chinese students who practiced their English on Archie while he practiced his beginning Chinese on them, making "something to hear." Nevertheless "his ability to communicate seemed to easily overcome the language barrier. Wherever he went he was surrounded by people, some perhaps attracted by his height (he towered over the Chinese), but mostly by his obvious friendship and interest in them. I don't think Archie and Peggy ever passed a beggar without giving something, and there are millions of beggars in China."

When the Communists came in and drove them out, "it resulted in their getting a wonderful trip around the rest of the world in a very slow-moving freighter . . . a windfall indeed for this pair who love life and people as they do."

During 1949-50, back in the States, Mr. Stone started his present job as special representative for the executive offices of the International Harvester Company. Then came his third war, the so-called Korean police action, and again, from early 1951 to mid-1952, he served in Washington as chief of the Farm Equipment Section, and later chief of the Machinery Branch in the Office of Price Stabilization.

Here it came to light that some 80 percent of farm machinery dealers were still, voluntarily, using the same pricing policies established by Mr. Stone back in the hectic period of the OPA—evidence enough, say his colleagues, of Archie's amazing ability to be both realistic and right.

Resuming his work with the International Harvester Company, he acts as a roving ambassador from the high command of the company to the colleges and universities. He travels so much, often by automobile and usually accompanied by Mrs. Stone, that he seldom is at the office he has in Washington. Once in a while, however, they get back to the log cabin which he built "do it yourself" on Long Island some 30 years ago.

Archie's skill as a color photographer and his wife's talent as a painter help make their travels a delight as well as a duty. He has made at least three motoring visitations to every one of the 48 states.

Of memberships, Mr. Stone maintains a minimum. They include the National Grange—Patrons of Husbandry, Sons of the American Revolution, the Masonic Lodge, Congregational Church, and Rotary of which he is a past-president at Farmingdale. He joined ASAE in 1924, and in 1942-43 was chairman of the North Atlantic Section.

His authorship, too, is notable for substance rather than volume. It includes textbooks: "Farm Machinery," three editions; "Farm Tractors"; and "Machines for Power Farming," forthcoming this year—all published by John Wiley & Sons. Feature contributions to AGRICULTURAL ENGINEERING have dealt with garden tractors and the measurement of soil hardness. Bulletins,

(Continued on page 541)

ASAE Golden Anniversary Meeting

A spirit of confidence for the future, inspired by 50 years of successful development, was in the air at the Golden Anniversary Meeting of the American Society of Agricultural Engineers at Michigan State University, East Lansing, Mich., June 23 to 27. "Looking into the Future" had been selected as the theme for the meeting and visitors were given the opportunity to learn about methods of applying atomic power, solar energy, automation and many other new developments for production and processing of more foods and fibers for more people.

Registration for the five-day meeting reached an all-time high with a count of 1527 including 343 women and 244 children.

Preliminary activities started Saturday, June 22, with the Council opening its meeting at 2:00 p.m. Other early arrivals were putting finishing touches on extension exhibits while special futuristic displays were being readied for viewing. These displays contained many items which were shown for the first time — new applications of power and energy, new materials and new techniques. Such things as a free-piston gas-turbine tractor, a solar battery, tandem tractor and solar-powered miniature automobile were included.

Publicity

Public relations activities started early. Hudson Robbins, public relations specialist, Carl Byoir and Associates, New York, arrived in East Lansing three weeks prior to the meeting, through the courtesy of Thor Power Tool Co., and assisted Don Brown and the Public Relations Committee in the preparation of news releases and advance publicity, resulting in a most thorough world-wide news coverage.

Registration began 1:00 p.m. Sunday, in Shaw Dormitory. The Cabinet meeting was held in Kellogg Center at 3:00 p.m. A buffet supper at 5:00 p.m. was followed by special entertainment featuring Joan and Janice Williams with Hawaiian and Western acts. Professor Jim Hays and his mechanical cow performed to the enjoyment of both young and old. Music during the meal was furnished by Mrs. Harold J. Foster on the electric organ.

During the Cabinet meeting, Robert G. Morgan, membership chairman of the Quad City Section, explained a system used by his section in promoting membership. Ralph E. Patterson, chairman of Pennsylvania Section, described a slide series of agricultural engineering in action prepared by his section for showing to high school students. A letter, read by J. L. Butt, from Dale Hull explained the success the Mid-Central Section has had in its publicity program. A roll call showed a large proportion of Sections represented.

General Sessions

The Monday morning program began with a General Session. Gwynn Garnett, director of administration, Foreign Agricultural Service, Washington, D. C., and Glen L. Taggart, dean, International Programs, Michigan State University, spoke on the subject of world agriculture—the role of the scientist and engineer in food and fiber production. Lt. Governor Philip A. Hart, welcomed the group to Michigan.

Organized tours and special events were well attended. Tours of the campus and of manufacturing plants in the Lansing area were conducted Monday and Wednesday mornings. Special tours to the Detroit area were held on Thursday.

Rain Monday evening forced the group inside for the butter charcoal broiled chicken barbecue. Square dancing in Shaw Lounge with Joe Roe as caller rounded out the evening.

Philip Sporn, president of American Gas and Electric Corp., spoke on energy requirements and the role of energy in our expanding economy, and Arthur S. Flemming, president, Ohio Wesleyan University, (formerly director of Defense Mobilization), spoke on the nation's interest in scientists and engineers, during the General Session Tuesday morning. P. D. Sanders, editor, *Southern Planter*, Richmond, Va., opened the Wednesday afternoon General Session with a talk on the advancing front of science. The president's annual address, by Roy Bainer, followed. See page 513 for complete address. Following the president's address, the first award student paper was presented by its author, Irwin A. Eickmeyer, Illinois Student Branch. His subject was "Shock Loading on a Rotary Mower."

Business Meeting

At the annual business meeting which followed, special reports were presented on education and research by C.G.E. Downing, extension award winners by Frank W. Andrew, committee on fertilizer application by W. M. Carleton, student branch activities by Ewart Brundrett, and a special invitation to visit Santa Barbara, Calif., for the 51st Annual ASAE Meeting in 1958 by C. T. Rasmussen. Henry J. Barre was called upon and presented a resolution honoring J. Brownlee Davidson, first president of ASAE, deceased.

Annual Dinner

The ASAE annual dinner program was held Wednesday evening with D. B. Varner, vice-president of Michigan State University, as master of ceremonies. John L. McCaffrey, chairman of the board, International Harvester Co., spoke on the "Next 50 Years." C. A. Ocock and Howard W. Riley, charter members in attendance, were introduced and

(Above) A Massey-Harris-Ferguson scholarship for proficiency in the study of agricultural engineering is presented to E. Brundrett and N. Hannsmann of the 1957 graduating class of Ontario Agricultural College, Guelph, Canada, by J. L. Gourlay of the London Ontario branch of the Massey-Harris-Ferguson Ltd. *(Left to right)* J. L. Gourlay, E. Brundrett, and N. Hannsmann

(Below) John F. Thornton, agricultural engineer with (SWCRD, ARS), USDA, Columbia, Mo., is shown receiving the Fourth Annual Sears Roebuck Research Award in Georgia for 1956. The award was "for the scientist who, during the year 1956, made the most significant contribution to Georgia's agriculture," and was the result of his research on moisture use by cotton in Piedmont, Ga. Among those present at the presentation ceremony in Athens were *(left to right)* J. R. Carreker, agricultural engineer, (SWCRD, ARS), USDA; E. Broadus Browne, director, College Experiment Station, University of Georgia; John F. Thornton; and J. C. Haynes, director of Public Relations, Sears, Roebuck and Co., of Atlanta

received a fine ovation. Mr. Riley gave a brief report of the first meeting of the Society 50 years ago. Special tables were set up for past-presidents of the Society and for executives of industry. A picture of past-presidents who attended the meeting, will appear in the August issue of AGRICULTURAL ENGINEERING.

A special feature of the banquet was a pageant entitled "50 Candles to Light the Future" presented with special lighting and sound effects and narrated by a member of MSU's speech department. Important events in the Society's history were unveiled in the dramatic presentation and were climaxed by the entrance into the darkened dining room of a huge birthday cake decked with 50 sparkling candles.

R. H. Driftmier, chairman, division of agricultural engineering, University of Georgia, received the Cyrus Hall McCormick Medal; and Archie A. Stone, special representative for the executive offices of the International Harvester Co. in Washington, D. C., received the John Deere Medal.

Student Activities

Cited as Student Honor Award winners for outstanding scholarship and participation in student activities were Kermit O. Allard, University of Maine; James B. Allen, University of Illinois; Larry O. Bagnall, State College of Washington; Julius S. Baird, University of Arkansas; Frank W. Bauling, University of Illinois; George Bloomsburg, University of Idaho; Galen S. Bridge, University of Maine; Allen F. Butchbaker, Michigan State University; Dayle Carlson, University of Idaho; Robert E. Davis, Iowa State College; Douglas L. Deason, Mississippi State College; David L. Donley, Pennsylvania State University; Donald A. Flasch, Oklahoma A & M College; John Hermanson, Iowa State College; Carrol P. Killough, Texas A & M College; Jerry B. King, Texas Technological College; Fred W. Kiser, North Carolina State College; William C. Little, Alabama Polytechnic Institute; Myron L. McCunn, Iowa State College; James W. Nance, Texas Technological College; Maurice L. Paul, University of Illinois; Hugh V. Piper, University of Arkansas; Cornell E. Read, Mississippi State College; Wayne E. Roberts, Oregon State College; Kenneth L. Sacks, Pennsylvania State University; Harold Sattler, Texas A & M College; Duane Satterlee, Michigan State University; Isaac Sheppard, Jr., Michigan State University; John B. Simpson, State College of Washington; Sherwood D. Skinner, Virginia Polytechnic Institute; Edward L. Stout, Iowa State College; R. Kern Stutler, Colorado State University; Gerald E. Thierstein, Kansas State College; Victor J. Thompson, Kansas State College; James H. Watson, Kansas State College; John M. Webster, University of British Columbia; John C. Williams, Pennsylvania State University; Kenneth C. Williamson, Alabama Polytechnic Institute; and Milton C. Woodlief, North Carolina State College.

FEI Trophy Awards were presented at a student dinner, Tuesday evening, with the compliments of the Farm Equipment Institute. The Georgia Student Branch was the Group A winner, with honorable mention to the North Carolina and Ohio Branches. The winner in Group B was the Maine Student Branch, with the Alabama and Oklahoma Branches, receiving honorable mention.

ASAE MEETINGS CALENDAR

August 3-7 — VIRGINIA SECTION OUTING, 4-H Camp Farrar, Virginia Beach, Va.

August 27, 28 and 29 — NORTH ATLANTIC SECTION, University of Delaware, Newark

October 23-27 — PACIFIC NORTHWEST SECTION, Compton Union Bldg., State College of Washington, Pullman

December 15-18—WINTER MEETING, Edgewater Beach Hotel, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Frank P. Hanson, perpetual master of ceremonies for FEI-ASAE student dinners, presided. He introduced R. S. Stevenson, president of Allis-Chalmers Mfg. Co. and chairman of the executive committee of the Farm Equipment Institute. L. H. Skromme, chief engineer, New Holland Machine Co., spoke to the group on "Your Future in the Farm Equipment Industry."

A special program for public lands and public works extended through Thursday. Also held on Thursday was an extension seminar. On Thursday and Friday a graduate teaching seminar in agricultural engineering dealt with the problems of graduate training objectives and development.

A separate report on the extension exhibits will appear in an early issue.

Meeting of Joint Committee on Grassland Farming

A meeting of the Joint Committee on Grassland Farming will be held at Stanford University in Palo Alto, Calif., August 29. A field bus tour is scheduled for August 30.

The morning session will cover papers on the history and functions of the Joint Committee on Grassland Farming and research needs for a billion acre crop, by Willis A. King; breeding alfalfa for disease and insect resistance, by O. F. Smith; disease problems in grass seed production and their control, by J. R. Hardison; quality and persistent varieties of forage crops through a breeding program, by J. R. Cowan; and on seed certification, by A. G. Law.

Topics for the afternoon meeting will include maximum carrying capacity through better management of irrigated and dryland pastures, by V. P. Osterli; seedling and fertilization of California ranges for increased productivity, by L. J. Berry; control of woody plants on western ranges, by O. A. Leonard; altitude relationships on plant form and survival, by Jens Clausen; and environmental stresses on grassland seedling survival, by H. M. Laude.

. . . Medalists

R. H. DRIFTMIER

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is a member in his own right, and served as chairman and vice-chairman of its agricultural engineering section. He is a member and past-president of the Southern Association of Agricultural Engineering and Vocational Agriculture. He was vice-chairman of the Rutgers Farm Buildings Institute in 1944-45. For some years he was farm buildings editor of Progressive Farmer and editorial consultant to Agricultural Associates, Inc.

As an author, Mr. Driftmier inclines to the popular rather than the bookish. His farm magazine articles have been so numerous that he does not bother with a bibliography. He does, however, mention co-authorship of a series of articles in AGRICULTURAL ENGINEERING on the septic tank method of sewage disposal, and another article which in 1946 won an ASAE Paper Award. He also is author, co-author, and contributor to many Georgia bulletins. Of the latter, or of their underlying research, friends recall with grim glee how once he got to the bottom of his subject by falling into a septic tank. (They also tell how, as a bridge table addict, his own face reflects the faces in his hand, or the lack thereof.)

Besides the parents, the Driftmier family consists of two each of boys and girls—John Frederick, Betty Jo, Helen Marie and Rudolph Henry, Jr.; and four grandchildren, one of whom is deceased.

A. A. STONE

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monographs, and sundry articles in various publications cover similar scope.

Mrs. Stone (Rowena, nee Spillane) is daughter of a one-time financial editor of the *New York Sun,* later of the *Philadelphia Public Ledger.* A devotee of painting at some of the Washington galleries, she also drew the illustrations for Archie's textbooks.

They have two sons. Archie A. Jr., a civil engineer, was chief engineer on the Seyhan River hydroelectric and flood control project in Turkey, and presently is employed by Morrison Knudsen Company and International Engineering Company of San Francisco. Richard S. is an atomic physicist engaged in atomic power research at Knolls Atomic Power Laboratory, Schenectady, N. Y.

From the warmth of admiration expressed by those who have known him well in his varied capacities, it would be hard to say which aspect of his career manifests the most merit. But perhaps his greatest contribution to engineering and to agriculture was the least spectacular—the long years in which he helped the Long Island Institute grow from comparative obscurity as a local part of the University to national and international distinction in its own field and in its own right.

EVENTS CALENDAR

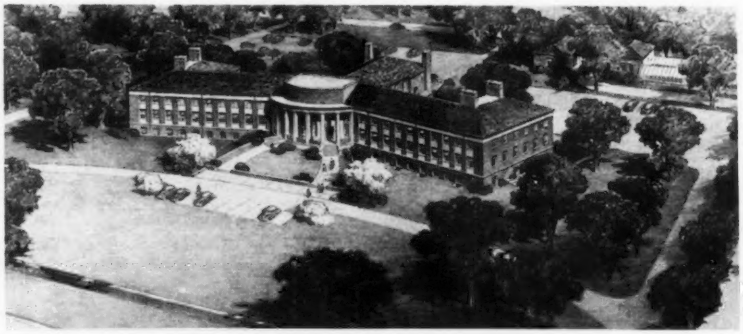
August 28-31 — *Soil Conservation Society of America,* Asilomar Beach State Park, Pacific Grove, Calif. For more information write to H. Wayne Pritchard, Executive Secretary, 838 5th Ave., Des Moines 14, Iowa.

August 29 — *Joint Committee on Grassland Farming,* Stanford University, Palo Alto, Calif. A field bus tour is scheduled for August 30.

September 23-25 — Sixth annual meeting of the *Standards Engineers Society,* Hotel Commodore, New York, N. Y. For more complete information write to Herbert G. Arlt, Bell Telephone Laboratories, Murray Hill, N. J.

Virginia Section

The Virginia Section plans an outing for August 3-7 in Virginia Beach at 4-H Camp Farrar. The camp is located near the ocean and will make a nice vacation for the family. Recreational facilities are available for both children and adults. Cottages will be assigned to families on a first-come, first-served basis.



(Above) Agricultural Hall, University of Delaware, Newark, is the meeting site for the North Atlantic Section, Aug. 27-29. It is located at the entrance to the 500-acre University research farm

Quad City Section

A meeting of the Quad City Section was held April 26, and included an election, tour of the Alcoa plant and three technical discussions.

The national president, Roy Bainer, spoke on new harvesting developments; E. S. Rumley discussed long range product planning and Howard H. Nuernberger talked on the application of aluminum to farm equipment.

Newly elected officers for the coming year are as follows: Chairman, E. G. Rowlett; vice-chairmen, Mahlon Love and Bruce A. Genzel; secretary, Bruce C. Arnold; and treasurer, John W. Ackley.

North Atlantic Section

The North Atlantic Section meeting will be held August 27-29 at the University of Delaware in Newark. The general program will begin Tuesday morning, August 27, with Section Chairman H. N. Stapleton presiding. Greetings will be given by National President Earl D. Anderson and an address of welcome will be presented by George Worrilow from the College of Agriculture, University of Delaware; also a panel discussion will be held. The afternoon session will include three concurrent programs — joint meeting of farm structures and rural electric div.; farm power and machinery; and soil and water. A chicken barbecue will be held at 6:30 followed by committee meetings later in the evening.

Wednesday morning, August 28, four concurrent sessions are scheduled — soil and water program, rural electric program, power and machinery program, and farm structures program. The afternoon and evening will be devoted to optional tours and recreation.

General sessions will be held both morning and afternoon on Thursday, August 29. Papers will be presented during the morning on instrumentation and in the afternoon on energy. A business meeting will close the afternoon session. The annual banquet program is scheduled for the evening.

Ohio Section

The Ohio Section met April 27 at the Ohio Agricultural Experiment Station in Wooster with a total of 79 members and guests in attendance. The highlight of the meeting was an address by ASAE national president, Roy Bainer, on modern research in agricultural engineering.

The following section officers were elected for the coming year: Chairman, Robert C. Evans; vice-chairman, William R. Schnug; and secretary-treasurer, Charles L. Hahn.

Rocky Mountain Section

A meeting of the Rocky Mountain Section was held April 5-6 in the agricultural building at the University of Wyoming, Laramie. Roy Bainer, president of ASAE, was the dinner speaker.

The speakers scheduled for the program were Winfred G. Glover, Bureau of Land Management, Dept. of the Interior, Cheyenne, Wyo.; H. T. Persons; G. Earl Barbeck; Walter M. Carleton, USDA, Beltsville, Md.; Robert T. Lorenzen, Colorado A & M College, Fort Collins; Lambert H. Wilkes, New Mexico A & M College, State College; Earl D. Anderson, president-elect of ASAE; and Nolan Mitchell, Aerovent Fan & Equipment, Inc., Lansing, Mich. Staff members from the Colorado A & M College and the University of Wyoming presented a discussion on some equipment used for and problems involved in seeding grasses on range land.

The topics discussed were on waterspreading—a practice in a watershed development program; the upper Colorado River story; evaporation supression (a progress report); agricultural engineers — where to in education; the effect of moisture on the physical properties of grain; cotton mechanization; adapting buildings to new trends in agriculture; and on drying grain on the farm.

(Above) New officers of the Quad City Section receive words of encouragement from Roy Bainer *(left)*, ASAE president. *(Left to right, front row)* chairman, Ed Rowlett, Torrington Co.; vice-chairmen, Mahlon Love, John Deere Harvester Works, and Bruce Genzel, Chain Belt Co.; secretary, Bruce Arnold, J. I. Case Co.; *(second row)* nominating committee, Marlin E. Weakly, John Deere Harvester Works, and Martin Berk, John Deere Spreader Works; retiring chairman, Roy Harrington, Deere & Co.; treasurer, John Ackley, John Deere Planter Works

(Right) Speakers who appeared on the Rocky Mountain Section program, April 5-6. *(Left to right)* Norman Evans, new section chairman; Earl D. Anderson, ASAE president-elect; W. M. Carleton, asst. chief, Agr. Eng. Branch, ARS; Roy Bainer, ASAE president; Karl Powers, section chairman

IVAN D. WOOD

C. W. BOCKHOP

D. E. SCHWENDEMANN

AUBREY L. SHARP

H. E. BESLEY

Ivan D. Wood, Past-President and Fellow of ASAE, has retired from his work as an engineer with the federal extension service, USDA. He has had a long and busy career and has been called a "grass roots" teacher.

He was born in 1888 at La Platte, Nebraska. In 1912 he graduated from the University of Nebraska with a B.S. degree in agricultural engineering—one of the first in the United States to be graduated with this degree. A year later he received a master's degree. He became extension engineer of the state agricultural extension service in 1914—something new in Nebraska and almost new anywhere. After service in World War I he served as state extension agent from 1919 to 1940 with the exception of two special assignments on irrigation and water conservation with the U.S. Forest Service.

In 1940 he became district and area engineer in the 17 western states for the Farm Security Administration, Denver, Colo. Mr. Wood was appointed irrigation engineer in 1945 with the Soil Conservation Service and in 1954 irrigation specialist for the Federal Extension Service. His major interest has been that of soil and water management. He is said to have been a trail blazer in soil erosion control.

He became a member of ASAE in 1919. In 1952 he was elected president and received the John Deere Gold Medal Award. In recognition of his productive service he was the recipient of the honorary degree of doctor of agriculture from the University of Nebraska in 1954 and was one of three extension agricultural engineers to receive a USDA Superior Service Award in 1956.

Clarence W. Bockhop has been appointed as head of the agricultural engineering dept., University of Tennessee, effective July 1.

Mr. Bockhop received a B.S. degree in agricultural engineering from Iowa State College in 1943. In 1942 he was elected the national first vice-president of the Student Branch of ASAE. Following graduation he joined the U.S. Army where he served until 1946. After his release from service he was employed by The Stewart Co., Ford tractor distributors of the State of Texas, for about six years, working as education manager, district supervisor and as service manager.

In 1953 he returned to Iowa State College and received an M.S. degree in agricultural engineering in 1955 and a Ph.D. degree in 1957.

Donald E. Schwendemann has been appointed as manager, organization and business management, and **Chester B. Clum,** as Chicago regional manager for the Detroit Diesel Engine Division of General Motors.

Mr. Schwendemann, formerly Chicago regional manager, will be responsible for business management programs for distributors and will establish and administer policies designed to assist the distributor organization. He first joined General Motors in 1946.

Mr. Clum graduated from General Motors Institute with a B.A. degree and first joined Detroit Diesel as a GMI student in 1943. Following graduation he served in various sales department positions within the division before being transferred to the Chicago office as a zone sales manager.

Aubrey L. Sharp has been transferred from his work as hydraulic engineer with the Soil Conservation Service, USDA, in Portland, Ore., to the Agricultural Research Service at Lincoln, Nebr.

He will be supervisory hydrologist for a coöperative water yield procedures study being undertaken by ARS, SCS, and U.S. Bureau of Reclamation. The objective of the study is to develop methods of estimating the quantitative effects of conservation treatment of land on water yields of streams and rivers.

Harry E. Besley, chairman of the agricultural engineering department at Rutgers University, New Brunswick, N. J., was recently notified of his promotion to the rank of brigadier general in the U. S. Army Reserve.

He received his commission as a second lieutenant, Engineer Reserve in 1930 and participated in ORC training until entering extended active duty in 1941. In 1945 he went overseas and while on active duty attended courses of instruction at the Engineer School, The Command and General Staff College and The British Staff College. Since relief from active duty in 1946, he has been a member of the U.S. Army Reserve, serving as course director for the special associate courses, C & GS, in the First Army area from 1948 to 1957; also as commandant of the Kearny, (N. J.) USAR School from 1950 to 1955; and is now commanding general of the 419th Engineer Brigade.

Mark Kulp, state reclamation engineer in Boise, Idaho, and former member of ASAE, has been awarded a Doctor of Science degree from the University of Idaho. From 1931 to 1944 he served as associate professor and irrigationist in the agricultural engineering dept. of the University, where he made contributions to the teaching profession and technical literature dealing with problems of hydrology and irrigation engineering.

Mr. Kulp has been called the "protector and promoter of water resources for the citizens of Idaho."

Ralph P. Prince, formerly assistant professor of agricultural engineering, at Pennsylvania State University, has accepted a position in the agricultural engineering department at the University of Connecticut. His work will be essentially research.

NECROLOGY

Harold M. Stueland, project engineer for John Deere Spreader Works, East Moline, Ill., died June 10 after an illness of nine months.

Mr. Stueland was born in 1903 in Humbolt County, Iowa. His technical education was limited, but his experience and productivity qualified him for full membership in ASAE in 1952. He was very active in design work, holding numerous patents, most of which were assigned to Deere and Company. He had been employed by John Deere Spreader Works since 1939 and progressed from field testing, to factory service draftsman, to designer. In 1944 he was promoted to project engineer, the position he held at the time of his death.

Elmer O. Engvall, designer, International Harvester Co., Moline, Ill., died May 8. He joined the company in 1936 as a draftsman and has supervised design and engineering.

Mr. Engvall was born at Moline, Ill., in 1903. Following graduation from high school in 1922 he worked for Western Electric Co., in Chicago, Ill., where he designed manual and dial systems telephone circuits. In 1927 he accepted a position with Western Electric Co., of Kearny, N. J., designing toll, long lines circuits, local cable layout, and teletype equipment. He has been a member of ASAE since 1955.

Victor B. Fredenhagen, a retired engineering specialist for the Soil Conservation Service, USDA, died after a brief illness in Lincoln, Nebr., February 27.

Mr. Fredenhagen was born at Greggs, Ill., in 1888. He graduated from the University of Illinois in 1910 with a B.S. degree in civil engineering. After graduation he was employed as a civil engineer by the Illinois Highway Department, and prior to his retirement he served for 22 years in the Soil Conservation Service. He joined ASAE in 1937.

. . . President's Address

(Continued from page 513)

ervoir of potential members. If they enjoy participation in sectional programs, as they did at both the Pacific Northwest and Rocky Mountain Section meetings, there is little doubt regarding their transfer to active membership upon graduation.

Two of the greatest milestones in the progress of the profession has been the publishing of a series of textbooks under the sponsorship of the Ferguson Foundation and the accrediting of 25 of the 44 agricultural engineering curriculums by ECPD. Of the remaining one-third, several are working toward an accredited program. This places agricultural engineering training at most institutions on a par with that in other engineering disciplines. Furthermore, the trend toward more and more graduate work is doing much to raise the level of professional training in the field.

Research and development in the agricultural engineering field in recent years have followed the trend of other fields toward complexity. Typical examples include the mechanical cotton picker; attempts to harvest tree, vine, and vegetable crops mechanically; the use of electronics in the color sorting of fruits and vegetables, metal detection in pneumatically conveyed livestock feeds, and the detection of blood spots in eggs; environmental control for frost protection and livestock production; vacuum cooling; freeze drying, etc. It is evident that as the problems become more difficult, the research worker will need more technical training. This naturally leads into specialized post-graduate instruction.

The example of the use of electronics in agriculture might be expanded. In the first place, the use of this important tool is practically unlimited. At the present time the application of electronics in the field of defense, such as guided missiles, aircraft controls, aircraft spotting, etc., has reached great heights. The demand for these developments has resulted in the organization of hundreds of new electronics firms. They have searched the country and have been highly successful in hiring most of the available qualified personnel capable of working in the field. Up until now, attempts to interest many of these firms in building electronic equipment for use in agriculture have been fruitless. As long as they have all the work that they can do with the security of a cost-plus basis, they will probably not become interested in agricultural problems. On the other hand, should this country reach some sort of disarmament agreement with other nations, or should the Government well start to run dry, a great interest in agricultural problems will develop overnight.

We, as agricultural engineers, have the choice of preparing ourselves and moving into the agricultural electronics field or waiting until it is taken over by the electronics engineers. If we are content to wait, we will find ourselves in the same position as the mining engineers were when the chemical engineers, who had been better trained in metallurgy and processing, moved in and took over. The same thing could be said for many other fields that might involve other engineering disciplines. Typical examples having a definite place in agriculture are heat transfer, mass transfer, processing, environment control, power development, work efficiency, etc. In other words, the agricultural engineer has developed a real field of work for the engineer in agriculture. There isn't a single engineering problem in agriculture, however, that couldn't be solved by an engineer in some other branch, provided he recognizes and successfully deals with the biological variables.

Since the field of agricultural engineering is pretty well defined and many types of engineers are finding it a productive field of endeavor, there must be a general awakening as to how and where we will fit into the future picture. The only way we can be assured of continued leadership is through strong research programs and the development of a superior training program — one that encourages qualified men to continue their training beyond the Bachelor's level.

We, as agricultural engineers, must develop a greater degree of cooperation with other scientists in agriculture. We must also recognize that on the average their technical training has exceeded ours by about two years and that in many cases they are better able to lay out an experimental procedure than we are. In general, they recognize the place of engineering in agriculture and have great respect for its accomplishments to date. Actually, many of them are initiating work involving the agricultural engineer. An excellent example was the work of the foremost cotton breeder, George Harrison†, who once gave a paper before this Society on the general subject of breeding cotton for mechanization. In the early days of the cotton mechanization project, his whole efforts were turned toward improving cotton plant characteristics to improve mechanical harvesting. Any selection or new type that didn't show promise of adaptation to mechanical harvest was discarded or reworked. The same thing can be said regarding the viticulturists at the California station, who worked on the retrellising of vines to better position the grape clusters for mechanical harvest. Within the first year, when the results appeared promising, they invited the agricultural engineer in to study the possibilities of removing the clusters mechanically. Now the pomologists are considering the possibilities of reshaping the peach or pear tree to reduce damage to fruit removed for the cannery by mechanical means.

One of the foremost problems confronting agriculture today is soil compaction. The heavier mechanical equipment developed by the agricultural engineers has no doubt been one of the major factors contributing to this problem. Its solution will demand concerted group effort involving the soil physicist, the plant scientist, and the engineer. The plant and soil scientists at the Citrus Experiment Station, Riverside, Calif., set up an experiment to determine the effect of tillage in citrus groves upon water penetration and yield. Part of the grove was cultivated in the normal manner while the balance was not cultivated. The weeds in the untilled section were controlled with oil sprays. At the end of four years, the water penetration in the untilled section exceeded that in the tilled area by 50 percent, resulting in a 33 percent increase in yield. At present, many thousands of acres of citrus in southern California are not cultivated. Similarly, many other problems in agriculture will depend upon team effort for solution.

The improvement of equipment performance offers one of the most attractive areas of work for the agricultural engineer. With few exceptions, the substitution of machines for hand operations has resulted in field losses or a general lowering of the quality of the product. For example, the combine, which was originally developed for harvesting small grains, is now used for the harvesting of many other crops. As its use is extended, additional problems arise. It is well known that if the amount of material passing through the combine is uniform and within the operating range of the machine at all times, the results will be quite satisfactory. Some regulating device is needed on the combine to insure that the intake of material will always be in the satisfactory range for optimum operation. In the average self-propelled combine the seed loss over the shoe and straw walkers increases at some exponential rate when the feed rate exceeds about 100 pounds (excluding grain weight) per minute. A device to control the speed of the forward travel of the machine in relation to the feed rate would solve this problem. With present cotton harvesting equipment the quality of machine-picked cotton averages one grade point below hand-picked cotton. This reduction in grade may represent a loss of 5 to 10 percent of the total value of the crop. Much of the grade loss is due to leaf and stem trash in the lint. This situation provides an excellent example of the way scientists in other fields might contribute through research: part of the solution to this problem might come from the plant breeder or botanist through the development of a self-defoliating variety or a satisfactory chemical means of inducing defoliation.

The quality factor extends far beyond machine operations. It involves crop conditioning, grain drying and storage, refrigeration and packaging of fruit and vegetables, seed cleaning and processing, and many other operations in agriculture.

Time-and-motion (work-efficiency) studies are revealing many areas where the output per worker can be materially increased with proper modifications in structures and equipment selection and arrangements. For example, some preliminary cooperative studies of machine-milking operations, made by the U.S. Department of Agriculture and the California station, showed that the number of cows milked per worker varied from 10 to 55 with an average of 30. Certainly the less efficient operations will have to be improved or they will eliminate themselves.

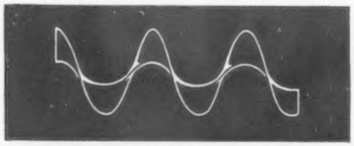
Materials handling offers a real challenge to the agricultural engineer. For example, the materials handled annually in the operation of an 80-cow dairy amount to approximately 2,000 tons. Much progress has been made through the use of pipeline milkers, bulk handling of milk, mechanical gutter cleaners, etc. However, the forages are still bulky and not adapted to systems of free flow. Currently, much effort is being directed toward the pelleting of forages such as hay. A successful, economical field method for reducing the volume of forages would be a boon to automatic feeding of livestock. Furthermore, the costs of handling this denser material into and out of storage would be reduced to a minimum.

Much progress has been made since the development of the first combine 100 years ago (about 70 miles from where we are meeting today), the first tractor, and the first rural extension of electric service at the turn of the century. Anniversaries call for inventories. Progress has been great. The problems ahead are even greater. We can't "rust on our laurels"; there is still much left to do.

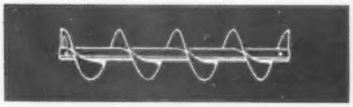
†Harrison, George J. Breeding and adapting cotton to mechanization. AGRICULTURAL ENGINEERING, 32:386-88, September, 1951.

Flexible in application . . . versatile in operation

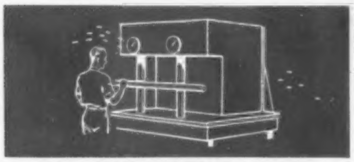
Link-Belt augers simplify design



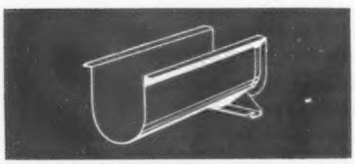
SELECTED FLIGHTING for all your auger needs. Helicoid, sectional or a range of other types of flighting are available in the metal and finish best suited for your design.



SIMPLICITY OF CONSTRUCTION and sturdy design of Link-Belt augers provide dependable, efficient operation on your machine. One basic assembly with no other moving parts to break down.

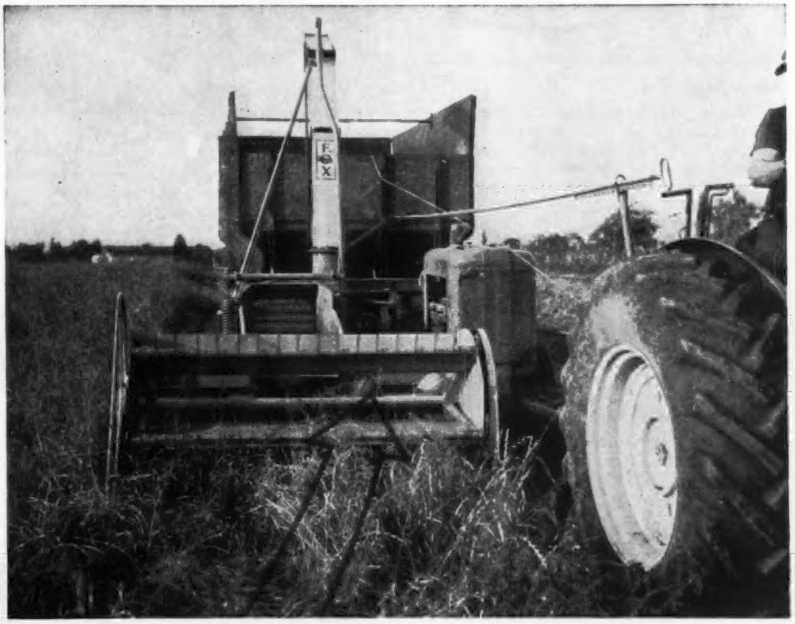


YOUR CHOICE OF METALS answers your requirements for handling corrosive or abrasive materials. And Link-Belt uses only specially selected steels to assure a uniform product.



ALL COMPONENTS — conveyor screws, collars, couplings, hangers, troughs, trough ends, flanges, drives —are available for every design.

ENGINEERING SERVICES. Our auger specialists will help you analyze your special needs . . . integrate all elements of your design.



LINK-BELT AUGER helps this Fox heavy-duty forage harvester convert standing green hay into silage ready for silo or dehydrator in one operation. Auger represents one of many types designed and built by Link-Belt for modern farm implements.

You can be sure of efficient operation, long life and low maintenance when you make a Link-Belt auger part of your equipment.

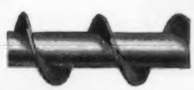
Link-Belt has a wide selection of augers, many of a specialized design, in a full range of diameters, gauges and pitches. They're accurately made to assure easy assembly, smooth, dependable operation. In addition, all components can be adapted to your particular design.

Whether it's a new application for your present machines or an entirely new concept, simplify your design problems by specifying Link-Belt augers. Call your nearest Link-Belt office for complete information.

Typical LINK-BELT augers

Helicoid flight with plain beater

Opposed flights with center saw-tooth beater



Sectional flight

Helicoid flight

Unmounted Helicoid flighting

Write for LINK-BELT Screw Conveyor Book 2289

LINK-BELT

THE SYMBOL OF QUALITY LB LINK-BELT

FARM MACHINE AUGERS

14,480

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

For more facts circle No. 9 on reply card

New Plow Line

Tractor and Implement Division, Ford Motor Co., has introduced a new line of tractor-mounted moldboard plows, featuring rugged truss-frame construction, good trash clearance, convenience of adjustment, and extensive parts interchangeability.

One, two and three-bottom plows with standard or replaceable shin-and-share bot-

toms ranging in size from 10 to 18 in. and in four moldboard shapes are offered. Easy conversion of two-bottom plows to three-bottom units, and adaptability to use with Ford or Fordson Major Diesel tractors is possible under the component plan of merchandising plow frames, bottoms and accessories.

(For more facts circle No. 75 on reply card)

Insulated Roof Decks

Johns-Manville has introduced a new insulating roof deck slab which provides in one material and in one operation a roof deck, a finished ceiling in open beam construction and insulation against heat or cold.

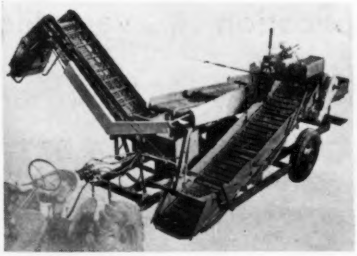
This deck is a rigid roof slab made of three or more laminations of wood fiber board bonded together with a strong adhesive compound. The slabs are 2 ft wide by

8 ft long. Thicknesses are 1½ in., 2 in. nominal or 3 in., depending on amount of insulation required. The long edges have an inter-locking joint. Short edges have a simple step joint. Deck sections are nailed directly to the roof framing members. No caulking at the joints is needed and the material is available either with or without vapor barrier.

(For more facts circle No. 76 on reply card)

New Potato Harvester

John Bean Div., Food Machinery and Chemical Corp., has announced a new 30-in potato harvester designed to provide high capacity and maximum protection for crops. The Model 30 features rubber covered rods.



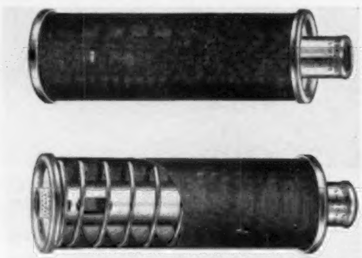
It can be used as a 1-row direct or 2-row indirect unit, and is easily converted from one operation to the other. All operations are handled by a crew of 2 to 5 men. Power is provided by a 13-hp air-cooled engine. Heavy-duty slip clutches are used on all major drives.

(For more facts circle No. 77 on reply card)

Suction Sprayer Strainer

Spraying Systems Co. has announced a new suction strainer for use in spray rig tanks.

The new strainer is made in choice of aluminum with Monel screen or of stainless steel with stainless steel screen. 50 and 100 mesh sizes are offered.



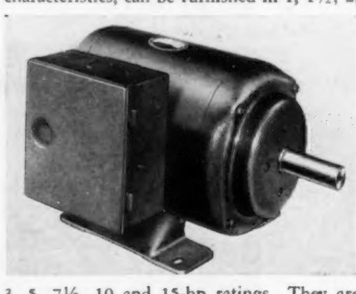
Hose shank connections are supplied to fit either ⅜ or ¾-in. OD rubber hose. The hose is slipped over the strainer hose shank and held with a hose clamp. No special fittings are needed. The new strainer is designed to fit through the opening of any standard container and permits withdrawal of solution to within one inch of bottom.

(For more facts circle No. 78 on reply card)

New Electric Motors

The Brown-Brockmeyer Co. has announced production of a series of new repulsion start-capacitor run single-phase electric motors.

These motors, which have high starting torque and low starting and running current characteristics, can be furnished in 1, 1½, 2,

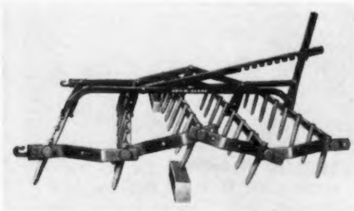


3, 5, 7½, 10 and 15-hp ratings. They are said to be especially suitable for applications having high inertia and heavy starting loads but where low running current is necessary. The new motors have oil-filled capacitors in their running windings which are said to require low running current.

(For more facts circle No. 79 on reply card)

New Lever Flexible Harrow

Deere and Co. has announced a new lever type flexible harrow with fused-in teeth. It has a 5½-ft tillage width, with 40 teeth per section providing a tooth pattern spacing of 1⅜ in. Flexible action is said to allow the



harrow to crawl over rocks and trash. Each diamond-shaped tooth is fused into its U-bar by a double projection weld. The lever provides nine settings, and the entire harrow can be locked rigid by using bolts in the end rails.

(For more facts circle No. 80 on reply card)

Hydraulic Hoist Attachment

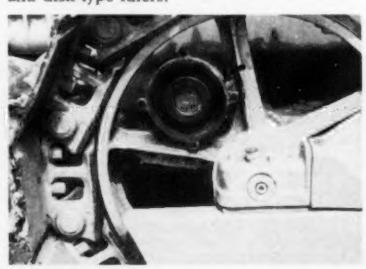
International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has announced a hydraulic hoist attachment for dumping McCormick No. 52 tractor trailers. The company states that trailers with hinged rear

brackets and front axle box supports, and carrying McCormick Nos. 10, 14 and 100 grain boxes, or other makes of similar barge or flared-type boxes, can be equipped with this hoist attachment. The hoist is activated by the tractor's hydraulic system.

(For more facts circle No. 81 on reply card)

Mileage Recorder For Track-Type Tractors

Caterpillar Tractor Co. has announced a new type odometer, which accurately records the distances traveled by track-type tractors. The unit can be mounted on both spoke-type and disk-type idlers.



The unit registers positive mileage in both forward and reverse gears. It is said to provide 98 percent accuracy in the lower three gear ranges. In fourth gear, 90 percent accuracy can be obtained. It is inoperative in fifth gear.

(For more facts circle No. 82 on reply card)

(Continued on page 548)

. . . New Products

(Continued from page 546)

Bin-Top Corn Crib

Pennington Mfg. Co., Addison, Ill., has announced development of what it calls the bin-top corn crib, as the latest addition to its line of bar-mesh corn cribs.

The bin-top feature is a 32-in band of steel under the eaves of the crib roof, designed to protect the open area that develops at the top of the crib when a full crib of corn settles. The purpose of the bin top is

to guard against accumulations of ice and snow that cause moisture rot. The new feature will also protect the corn from nesting and feeding birds. Attention to these problems has recently been intensified when government and private-loan agencies, who deal with on-the-farm storage payments, have wanted assurance that the crop will not deteriorate during storage.

(For more facts circle No. 83 on reply card)

German Air-Cooled Tractors To Be Sold in U. S.

Porsche-Diesel of America, Inc. has announced that air-cooled Porsche-Diesel tractors and engines produced in Germany will soon be available to American farmers. Units will arrive in the United States at an initial rate of 100 a month. Four models will be available, ranging from one to four-cylinder engines, with corresponding horsepower of 11 to 44. Features include an oil-operated hydraulic clutch, four or five for-

ward and reverse gears, hydraulic power lift, various shafts to drive working machinery, a crawling gear, adjustable track, and weight variation to meet particular requirements.

The one-cylinder Model P-111 is rated at 12 hp and weighs 1,826 lb. The Model P-122 has two cylinders, is rated at 22 hp and weighs 3,080 lb. Model P-133 (illustrated) has three cylinders, is rated at 33 hp and weighs 3,586 lb. Model P-144 has four cylinders, is rated at 44 hp and weighs 4,630 lb.

(For more facts circle No. 84 on reply card)

Low Profile for SP Combines

Massey-Harris division of Massey-Harris-Ferguson, Inc. has announced two new self-propelled combines. The new models—82 and 92—are successors to the 80 and 90 models and feature a low profile for greater stability and safety. According to the manufacturer, the new profile makes transporting and storing easier and safer. The hinged unloading auger can be swung back to clear barn or shed doors, bridges and

overheads. Transport height of the 82 is only 8 ft, 9 in.; 9 ft on the 92.

Threshing and cleaning units in the model 82 all measure 32 in. wide and are 37 in. wide in the 92. A 2-row corn head for field shelling is available. It is engineered to fit older models now in the field. The 82 is available with 14, 12 or 10-ft cutterbar. The model 92 offers a choice of 16, 14 or 12-ft cut. Both models are built in special edible bean and rice machines and a 92 hillside model is also available.

(For more facts circle No. 85 on reply card)

Portable Bucket Pump

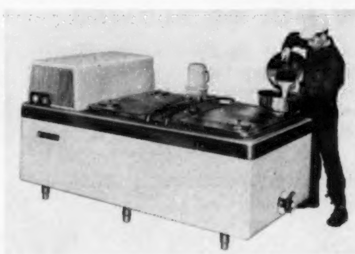
Alemite Div., Stewart-Warner Corp., has announced a new portable bucket pump featuring a patented adjusto lever designed to make it easy to pump either oil or grease in cold weather and at pressures of 2,500 to 5,000 lb. For use in industrial, farm and automotive fields, the pump is available in seven models for all types of lube fittings. The lubricant capacity is 35 lb, and the bucket pump is of oval design for easy carrying.

(For more facts circle No. 86 on reply card)

New Styling for Bulk Milk Coolers

Wilson Refrigeration, Inc., Division of Tyler Refrigeration Corp. has introduced a new line of bulk milk coolers. The new coolers are nearly 6 in. lower than before resulting in a pouring height of 36¼ in. on all models of 250-gal capacity and below.

Features include automatic agitation, rounded corners and new radius at external

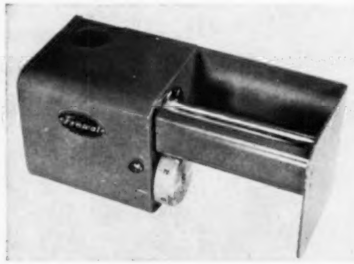


edges to speed draining. Other features include new greaseless, oilless agitator motor; new agitator blade design; new integral spray system; and new contour-expanded milk tanks that are said to eliminate calibration worries by preventing bulging or buckling. The new model coolers will be available in capacities from 100 through 700 gal.

(For more facts circle No. 87 on reply card)

Ventilation Controller

Fenwal Incorporated has developed a new ventilation controller, designed specifically to maintain uniform temperature and humidity in dairy barns and other livestock buildings. The controller is designed especially for service in livestock shelters, and for related ventilation and temperature-control applications in chicken houses and fruit storage structures.



The new ventilation control is a thermostatic unit which can be set to operate fans or other ventilation equipment when the barn temperature rises above the desired level. It is designed for accurate, reliable and trouble-free operation under typical barn conditions and is said to control temperature within 2 degrees F of set point.

(For more facts circle No. 88 on reply card)

New Measuring Wheel

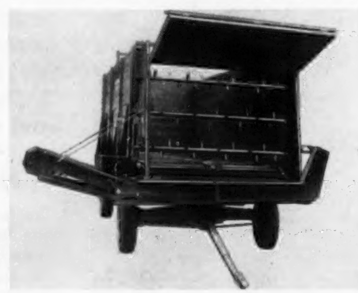
Rolatape, Inc. has introduced a measuring wheel for measuring long distance over fairly rough terrain. Its built-in tabulator records and measures distances up to 18 miles before resetting itself or it can be reset at any time.

(For more facts circle No. 89 on reply card)

Bunk Feeder and Beater Unloader

Calhoun Mfg. Co., Cedar Falls, Iowa, has developed a new slat bottom bunk feeder designed for feeding up to 100 steers in 3 min. Removal of the side conveyor converts the bunk feeder into a beater unloader.

The bunk feeder will handle grain, ground or whole, and any forage, green or



dry, or silage. The side conveyor may be operated at any height up to 45 deg and permits adjustment to the height of the bunk feeders. The conveyor always is in full view of the operator. Three unloading speeds are controlled by a handy lever. Three beaters tear up and distribute forage evenly in the blower, pit or surface silo, or in feed bunks. The beaters help to mix the feed during unloading, permitting the box to be filled partly with forage and partly with grain. The slat bottom moves on an endless chain. It is clutch-operated to enable the beaters to be started or stopped while running.

(For more facts circle No. 90 on reply card)

MANUFACTURERS' LITERATURE

V-Belt Drive Manual

Maurey Manufacturing Corp. — This 66-page illustrated manual contains facts and figures wanted by the production man, the engineer and the designer. It is divided into three general sections: V-drive selection, drive design section and a general information section.

(For more facts circle No. 51 on reply card)

Crawler Tractors

Caterpillar Tractor Co.—A 12-page booklet, entitled Big Tracks, form DE627, illustrates how the company's largest crawler tractors are engineered and manufactured and it explains the economics of the use of matched tools.

(For more facts circle No. 52 on reply card)

Roller Chain Catalog

Daido Corporation — A 16-page catalog No. 106 which describes and illustrates the different types of roller chain manufactured by the company. It includes specification charts and a sub-standard chain data chart. The catalog lists standard sizes of chains from ¼ to 2½-in pitch in single, double, triple and six widths. The roller chains are a combination of pin link and roller link and it is said that every part can be replaced.

(For more facts circle No. 53 on reply card)

Farm Implements Brochures

Allis-Chalmers Mfg. Co.—Brochure TL-1711 describes the new No. 310 one-way disk, designed primarily for the WD-45 tractor, but also available with hitches which adapt it for use with other tractors that are equipped with standard ASAE drawbar and remote ram.

Brochure TL-1691 is a fold-out piece featuring the new 200 Series row-crop cultivator for the company's D-14 tractor.

TL-1695 describes the No. 4 subsoiler designed for D-14, WD-45 and WD tractors.

TL-1700 gives data on the No. 63 3-bottom plow, also designed for the D-14, WD-45 and WD tractors.

(For more facts circle No. 54 on reply card)

Forage Profit Plan

Gehl Bros. Mfg. Co.—This 4-page folder contains a simplified system, based on impartial findings of agricultural colleges and research stations, to find forage harvesting costs. It contains three tables from which the farmer can pick his present method of hay or silage harvesting and can compare it quickly with other methods.

(For more facts circle No. 55 on reply card)

Welding Balance Positioner

Aronson Machine Co.—A 16-page bulletin No. UB57 featuring the company's patented universal balance positioner for welding. The bulletin describes five models with capacities of 25 to 2000 lbs. It includes schematic drawings, complete specifications and optional accessories.

(For more facts circle No. 56 on reply card)

Butyl for Tires

Enjay Company, Inc.—A 60-page illustrated loose-leaf manual describing the use of butyl for automotive and heavy-duty tires. It includes information on compounding, fabrication and performance of automotive tires, and heavy-duty tires for logging, construction, mining and farm equipment. An appendix lists tire component nomenclature, compounding ingredients, test specifications and procedures, evaluation of cure and thermal diffusivity and conductivity.

(For more facts circle No. 57 on reply card)

Hose and Fittings Catalog

Aeroquip Corp.—Catalog Bulletin No. 182 contains information on the company's line of industrial hose and fittings and is designed primarily for use in the replacement field. It includes instructions for ordering, installation planning and assembly of the company's hose and fittings.

(For more facts circle No. 58 on reply card)

Farm Gate Catalog

Clay Equipment Corp.—The 8-page booklet illustrates the company's line of steel gates, fence fabric, gate hardware and fittings. It also describes a tilting device which enables the owner to raise or lower the outer end of the gate, to permit pigs and chickens to pass while large animals are held back.

(For more facts circle No. 59 on reply card)

Perforated Metal Catalog

Standard Stamping & Perforating Co.— A catalog which shows hole sizes and patterns of perforated metal used in screens, seats, guards, grilles, steps, small parts, etc., for the manufacture of farm equipment.

(For more facts circle No. 60 on reply card)

Chain Catalog

Moline Malleable Iron Co. — An 8-page catalog illustrating and describing the complete line of chains made by the company. It covers all available types of conveyor, elevator and power transmission chains including mill chains, elevator buckets, and some new chain developments. It also shows methods of installing chain and how to identify chain attachments.

(For more facts circle No. 61 on reply card)

Filter Guide

Industrial Filtration Co. — This 8-page brochure illustrates 6 major filter types for industrial applications. Descriptions of filter operation are given as well as applications, degree of filtration and flow rate capacities.

(For more facts circle No. 62 on reply card)

Fork Truck

Clark Equipment Co.—A 6-page brochure describing the design, operation and advantages of the Clarklift-30, a gas-powered 3000-lb capacity model in a new line of fork trucks. It is illustrated by drawings and photographs. Graphs and sketches indicating grade and drawbar pull, turning radius and upright dimensions are also included.

(For more facts circle No. 63 on reply card)

Irrigation Pipe

Aluminum Company of America—a four-page folder gives brief information and specifications for three standard and light-weight seamless extruded and welded irrigation pipe.

(For more facts circle No. 64 on reply card)

Directory of Products and Services

Link-Belt Co.—Book 2653 is a 43-page booklet presenting a comprehensive idea of the company's scope, products and the industries they serve. It is a directory of standard products, engineered equipment manufacturing, sales and service facilities in the materials handling and power transmitting machinery lines.

(For more facts circle No. 65 on reply card)

Sleeve-type Roller Bearings

Caterpillar Tractor Co.—An 8-page brochure called "For Extra Hard Work," describes the savings and benefits of sleeve-type track roller bearings to track-type tractor owners.

(For more facts circle No. 66 on reply card)

Aluminum Gates

Aluminum Company of America—a four-page folder briefly describes construction and gives specifications for a general-purpose farm gate, 52 inches high and for openings of 10, 12, 14 and 15 feet.

(For more facts circle No. 67 on reply card)

Flexible Metal Hose

Universal Metal Hose Co.—A 9-page catalog which covers recommended pressures, temperatures and specific uses for each type of flexible metal hose manufactured by the company. Also described are the various types of hose including the styles and sizes of both the seamless, corrugated type and the interlocked type, with or without packing, as well as the styles of couplings used for each.

(For more facts circle No. 68 on reply card)

Peg-Board Panels and Fixtures

Masonite Corp. — A 12-page illustrated booklet called "Home Owners' Guide to Masonite 'Peg-Board' Panels and Fixtures" which describes various uses of the perforated hardboard panels and fixtures in and about the home. How-to-do-it information is included, and sketches of the matching metal fixtures and their applications are shown. Hints on decorative as well as functional applications of peg-board panels and fixtures are presented.

(For more facts circle No. 69 on reply card)

Fly Control Sprayer

Root-Lowell Corp.—A leaflet which describes the company's electric sprayer for the control of flies. Basic specifications for the sprayer are included and some illustrations are shown.

(For more facts circle No. 70 on reply card)

Graviometer

Royco Instruments — this leaflet describes an instrument for making rapid specific-gravity measurements in the laboratory. Illustrations show how, after the reading is completed, the material can be discharged directly into the original container or to waste as desired, without the operator's hands coming in contact with the fluid. Data is included on the two vessel sizes available and a list of the appropriate hydrometers is included.

(For more facts circle No. 71 on reply card)

Hose and Hose End Catalog

The Weatherhead Co. — This 40-page catalog is said to incorporate complete information on bulk industrial hose, permanently attached hose assemblies, swaged hose assemblies and ends, hose end swivel adapters, assembly instructions and installation data. It is designed for quick reference and easy ordering.

(For more facts circle No. 72 on reply card)

Fuel Pressure Regulator

Alondra Sales, Inc. — A two-color illustrated technical bulletin on how over-pressure causes carburetor flooding, explains how the company's "Filt-O-Reg" fuel pressure regulator is used on gasoline engines.

(For more facts circle No. 73 on reply card)

Galvanized Roofing and Siding

U.S. Steel Corporation—A 20-page booklet that illustrates the types and advantages of galvanized roofing and siding sheets. It is a handy guide for the do-it-yourself man to select roofing and siding materials to meet farm needs. Suggestions on the care and handling of galvanized steel sheets and on repair and maintenance are offered and steel roofing accessories are described.

(For more facts circle No. 74 on reply card)

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Adams, Roger R. — Student, University of Georgia (Mail) R.R. 2, Carnesville, Ga.

Alexander, Lloyd D. Jr. — Eng. trainee, Southern Bell Telephone Co., Atlanta, Ga. (Mail) 2568 Powell Lane, Apt. 6, Decatur, Ga.

Allen, Lee D.—Agr. engr., Alaska Agricultural Experiment Station, Palmer, Alaska

Allison, Eugene—R.R. 1, Smithfield, Texas

Barmington, Raymond D.—Assoc. res. engr., Colorado Agricultural Experiment Station, Fort Collins, Colo.

Bartlett, Lennard L.—Trainee, Southern Bell Telephone Co., Atlanta, Ga. (Mail) 2540 Memorial Dr., S.E.

Bawcum, Edsel W. — Test engr., International Harvester Co., Memphis, Tenn. (Mail) 3966 Argonne

Belcher, Ronald H.—Design engr. grade II, International Harvester Co., 1301 W. 22nd St., Broadview, Ill.

Betsill, Jerry M.—Jr. pipeline engr., Humble Pipeline Co., North Texas Div., Cisco, Texas (Mail) Doole, Texas

Bloomsburg, George L.—Res. Fellow, agricultural eng. dept., University of Idaho, Moscow, Idaho (Mail) 403 College

Boysen, Stephen M. — Agr. engr., SCS, USDA, Temple, Texas (Mail) 400 W. Chandler, Brownwood, Texas

Brannock, Elwood—Owner, Brannock Equipment Co., Box 126, Brooklyn, Mich.

Carlson, Dayle W.—Student, University of Idaho (Mail) R.R. 1, Firth, Idaho

Chapman, Robert M. — Student, University of Georgia (Mail) Oglethorpe, Ga.

Chiari, Olegario B.—Agr. engr., Servicio Interamericana de Cooperacion Agricola en Panama (Mail) Entrega General, Panama, R. P.

Chumney, Carl V.—The Lutcher and Moore Lumber Co., P.O. Box 621, Orange, Texas

Cooper, Forrest W. Jr. — Farmer, CSC Farms, P.O. Box 946, Florence, Arizona

Cox, Derald K.—Agr. engr., Bureau of Indian Affairs, Standing Rock, McLaughlin, S.D.

Curtis, Joseph L.—Agr. engr., SCS, USDA, Big Spring, Texas (Mail) P.O. Box 237, Floresville, Texas

Davis, Wilbur M.—Proj. engr., John Deere Engineering & Research Center, Waterloo, Iowa (Mail) 1804 Hawthorne St., Cedar Falls, Iowa

Deal, Larry G. — Engr. trainee, Westinghouse Electric Corp., Pittsburgh, Pa. (Mail) 306 College St., Montezuma, Ga.

Deason, Douglas L.—Farmer, Vaughn, Miss.

Decker, Raymond E.—Proj. engr., Food Machinery & Chemical Corp., P.O. Box 552, Riverside, Calif.

De Coursey, Donn G.—Grad. student, agricultural eng. dept., Purdue University, W. Lafayette, Ind.

Dickson, Elmer E.—Coordinating engr., Alexander Mfg. Co., Picayune, Miss. (Mail) R.R. 2, Box 49, Carriere, Miss.

Donnelly, Charles A.—Hydraulic res. engr., (SCS, SWCRD), USDA, St. Anthony Falls Hydraulic Laboratory, Third Ave., S.E. at Mississippi River, Minneapolis 14, Minn.

Dunn, Samuel F.—On duty with U.S. Army (Mail) R.R. 2, Greenville, Ga.

Emin, Nevzat H.—Jr. soil and water engr., SCS, Dept. of Agriculture, Nicosia, Island of Cyprus

Farmer, Charles G.—Trainee, research dept., Caterpillar Tractor Co., Peoria, Ill. (Mail) Pinola, Miss.

Farris, William D.—Patent examiner, U.S. Patent Office, Washington, D. C. (Mail) R.R. 1, Boones Mill, Va.

Fullilove, Henry M. III—Asst. agr. engr., Georgia Experiment Station, Experiment, Ga.

Gentry, Jerald D. — Box 18, Kenterville, Idaho

Gleason, Timothy P. — Production trainee, Ralston Purina Co., Ft. Worth, Texas (Mail) Box 36, Maysfield, Texas

Golombisky, Walter H.—Owner and operator, Golombisky Farm Trenching Service, R.R. 4, Ithaca, Mich.

Gunn, Martin S.—On duty with U.S. Army (Mail) 403 S. Main St., Greensboro, Ga.

(Continued on page 556)

If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the right.

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1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
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→ ***Please print or type your name, etc., below*** ←

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Your position or title...

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2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98

If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the left.

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Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

. . . Membership Applicants

(Continued from page 552)

Hall, Clarence L. Jr. — Production trainee, Ralston Purina Co., Tampa, Fla. (Mail) Apt. 10, Henrietta Apts., Athens, Ga.

Heitter, George M.—Agr. engr., Farmers Home Adm., USDA, Huron, S.D. (Mail) 1188 Colo, S.W.

Hulseberg, Paul J. — Asst. product engr., International Harvester Co., Memphis Works, Memphis, Tenn. (Mail) 1580 Alta Vista Rd.

Iacovone, Jacintho M. C.—Anderson, Clayton & Cia Ltda, Sao Paulo Brazil (Mail) Rua Conselheiro Carrao 268

Johnson, Wade W.—Trainee, Ralston Purina Co., Jackson, Miss. (Mail) R.R. 4, Rome, Ga.

Jones, Charles L.—Vice-pres. and sales mgr., Shenango Steel Bldgs., Inc., P.O. Box 301, West Middlesex, Pa.

Jones, Raymond L.—Field supervisor, Shenango Steel Bldgs. Inc., Box 301, West Middlesex, Pa.

Killough, Carrol P.—Field engr., field research div., Caterpillar Co., Peoria, Ill. (Mail) R.R. 2, Hubbard Texas

Landis, Edwin E. — International Harvester Co., motor truck div., Fort Wayne, Ind. (Mail) R.R. 4, Wabash, Ind.

Lewis, William G. — Sr. draftsman, John Deere Des Moines Works, Des Moines, Iowa (Mail) 209 School St., Ankeny, Iowa

Long, Joseph G.—Trainee, products application div., Research & Technical Center, The Texas Co., Beacon, N. Y. (Mail) Fishkill, N.Y.

Marciacq, Hector Jr. — P. O. Box 976, Panama City, Panama

Markey, Clarence J. II — Engr., Houston Lighting & Power Co. (Mail) 3109 Firnat St., Houston, Texas

Martin, Robert O.—Engr. in training, Firestone Tire & Rubber Co., Akron, Ohio (Mail) 4302 Buell Dr., Fort Wayne, Ind.

Massenburg, Edward S. — Student, North Carolina State College, Raleigh, N. C. (Mail) 2508 White Oak Rd.

Montgomery, John C.—Engr., Boeing Airplane Co., Seattle, Wash. (Mail) R.R. 3, Haskell, Texas

Parks, John R. — Agr. engr., SCS, USDA, Fulton, Mo. (Mail) R.R. 2, Perry, Mo.

Perry, Jesse P. Jr.—In charge of experiment station operations, The Rockefeller Foundations Mexican Agricultural Program, Calle de Londres, No. 40, Mexico City, Mexico

Pipes, John R.—Mill trainee, Ralston Purina Co., P.O. Box 1200, Ft. Worth, Texas

Rains, William L. — Trainee, service dept., Caterpillar Tractor Co., Peoria, Ill. (Mail) Box 272, Clarksville, Texas

Read, Cornell E.—Eng. trainee, Allis-Chalmers Mfg. Co., Milwaukee, Wis. (Mail) Bay Springs, Miss.

Ressler, Carl T.—Chief engr., Neapco Products, Inc., Cross & South Sts., Pottstown, Pa.

Roice, Charles D.—Dir. of farm equipment product planning, International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

Salehi, Ahmad — Student, California State Polytechnic College, P.O. Box 1972, San Luis Obispo, Calif.

Satterlee, M. Duane—Grad. student, Michigan State University, East Lansing (Mail) 702C Chestnut

Sattler, Harold — Grad. student, Oklahoma A & M College, Stillwater (Mail) P.O. Box 806, Kerrville, Texas

Schaper, Lewis A.—Student, Purdue University (Mail) 241 S. Grant, W. Lafayette, Ind.

Scott, Edward E.—Agr. engr., SCS, USDA, West Chester, Pa. (Mail) R.R. 1, Parkesburg, Pa.

Shelton, Lee E. — Proj. engr., Ingersoll Products, 1000 W. 120th St., Chicago, Ill.

Sheppard, Leighlus E. Jr.—Agr. engr., Central Power & Light Co., 120 N. Chaparral, Corpus Christi, Texas

Skelton, John—Hydraulic engr., U.S. Geological Survey, Jackson, Miss. (Mail) R.R. 2, P.O. Box 159, Clarksdale, Miss.

Skinner, Sherwood D. — Fire inspection engr. trainee, Factory Insurance Assn., Charlotte, N.C. (Mail) R.R. 1, P.O. Box 1, Skippers, Va.

Spamer, Alfred B.—Farm field engr., Portland Cement Assn., 512 Keyser Bldg., Baltimore 2, Md.

Stitt, James L.—Installations engr., U.S. Air Force, Box 978, 4083rd Installations Squadron, APO 23, New York, N. Y.

(Continued on page 558)

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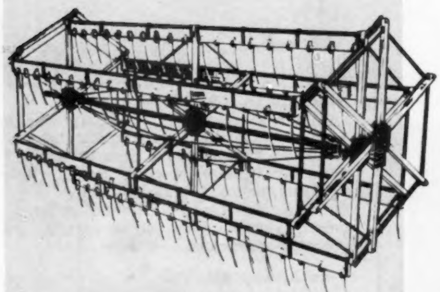

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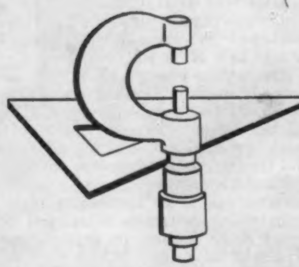

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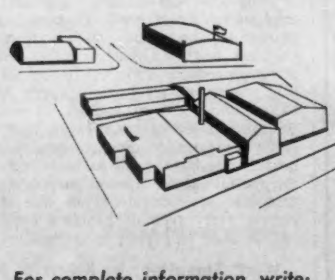

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. . . Membership Applicants

(Continued from page 556)

Stowers, Luther A. — Field engr. trainee, Lane-Wells Co., Houston, Texas (Mail) R.R. 2, Natchez, Miss.

Stritt, Albert R.—Agr. engr., Allis-Chalmers Mfg. Co., West Allis, Wis. (Mail) 7-24 152 St., Whitestone 57, L.I., N. Y.

Styner, Walter E.—Student, University of Idaho, Moscow (Mail) Campus Club No. 42

Turner, Hiram B.—Farmer, Luella, Georgia

Tyson, Willie J. — Training officer, U.S. Civil Service, Robins Air Force Base, Warner Robins, Ga. (Mail) R.R. 2, Perry, Ga.

Umback, Charles R. — Asst. agronomist, agronomy dept., South Dakota State College (Mail) P.O. Box 657, Lemmon, S. D.

Waddail, Robert A. Sr. — Design engr., Southern Harvester Co., Columbus, Ga. (Mail) 2801 15th Ave., Phenix City, Ala.

Walters, Robert E.—Student, University of Georgia (Mail) P.O. Box 242, Lexington, Ga.

Wilcox, Robert E.—Jr. engr. trainee, Temco Aircraft Corp., Dallas, Texas (Mail) 4722 Sandra Lynn Dr., Mesquite, Texas

Wiles, Robert A.—On duty with U.S. Army (Mail) Trent, S.D.

Will, Robert H.—Agr. engr., Carnation Co., Los Angeles, Calif. (Mail) 221 Polk St., Twin Falls, Idaho

Wilson, Howard D. — SCS, USDA, 941½ W. Huron St., Pontiac, Mich.

Woodrum, William L. — Eng. trainee, Southern Bell Telephone Co., Atlanta, Ga. (Mail) R.R. 3, Statesboro, Ga.

Zarrouk, Jafar M.—Agr. engr., Ministry of Development, Baghdad, Iraq (Mail) Karbala, Iraq

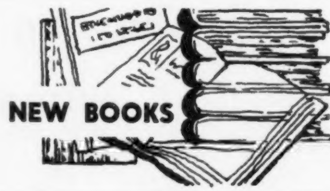
Zoch, Raymond M.—Design engr., Southern Harvester Co., Box 1260, Columbus, Ga.

Transfer of Membership

Corley, Tom E.—Assoc. agr. engr., agricultural eng. dept., Alabama Polytechnic Institute, Auburn, Ala. (Associate Member to Member)

Nir, Dov — Instructor, agricultural eng. dept., Israel Institute of Technology, Haifa, Israel (Associate Member to Member)

Thornton, John F. — Proj. administrator, (ARS, SWCRD) USDA, 204 Agr. Eng. Bldg., University of Missouri, Columbia (Associate Member to Member)



Basic Principles of Parliamentary Law and Protocol, by Marguerite Grumme. Paper, 4¼ x 5¼ inches, 68 pages, indexed. Marguerite Grumme, 3830 Humphrey St., St. Louis 16, Mo. $1.00

This basic manual is pocket size offering a compact visual aid for learning and quick reference. It contains the basic principles of parliamentary law (based on Robert's Rules of Order, revised) and a basic chart of motions. It also contains features such as a meeting agenda, convention agenda, club protocol, and protocol for the speaker.

Rural Appraisals, by Earl F. Crouse and Charles H. Everett. Cloth, 5½ x 8½ inches, xix+531 pages, illustrated and indexed. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. $6.00.

The authors present information, data and methods used by Doane Agricultural Service in training rural appraisers. The careful description of every element of sound rural appraisal presents an understanding and the knowledge of how to apply two important appraisal procedures on how to examine and judge features of rural properties which determine value, and how to report those features in an understandable expression of value.

Four chapters present appraisal tools, explaining topics such as mapping, field procedure, and soil classification. Two chapters describe Doane's concise soil evaluating procedure. A three-chapter section of case studies shows how to apply appraisal theory and tools in making an actual appraisal and setting basic value, how to find basic value under unusual conditions, and how to use basic value as basis for estimating special values. Special purpose appraisal problems are considered in five chapters. Nearly every type of problem encountered by the rural appraiser is covered.

Work Sampling, by Robert E. Heiland and Wallace J. Richardson. Cloth, 6 x 9 inches, x + 243 pages. Illustrated and indexed. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $6.00. *(Continued on page 560)*

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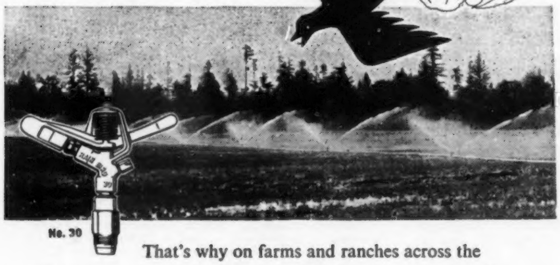

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. . . New Books

(Continued from page 558)

This book is reported to be a comprehensive "how-to" treatment of work sampling or economical method for work measurement for office work, machine accounting, drafting departments, etc., as well as factory operations. It explains the theory, furnishes statistical information, and gives instructions for planning, carrying out, and interpreting a study. It also shows how to take action on the basis of the results.

The authors point out that work sampling adds a new, valuable skill to the professional equipment of engineers, office managers, accountants, foremen, operations research personnel, time study and control workers, procedures and methods men, data processing supervisors and factory superintendents.

Weather Analysis and Forecasting (second edition, Vol. II), by Sverre Petterssen. 266 pages. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $6.00.

This volume deals with weather and the emphasis is on the thermodynamics of atmospheric processes. The book begins with a treatment of the exchange processes and develops the theory of air masses and thermodynamic processes. Then condensation and precipitation, convective clouds, showers, thunderstorms, squall lines and tornadoes are discussed. A separate chapter is devoted to fog and stratus; subsequent chapters deal with migratory cloud and weather systems. The last three chapters are concerned with the various dynamic and statistical techniques for predicting clouds and weather.

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listings.

POSITIONS OPEN—JANUARY—O-8-701. FEBRUARY—O-14-702, 14-703, 23-704, 23-705, 23-706, 12-707, 28-708, 38-709. MARCH—O-21-710, 52-711, 60-712, 45-713, 45-714, 81-715, 84-716, 70-717. APRIL—O-90-718. MAY—O-141-719, 141-720, 154-721, 154-722, 155-723, 164-724, 165-725, 99-727. JUNE—O-179-728, 189-729, 170-730, 188-721.

POSITIONS WANTED—FEBRUARY—W-13-1, 33-2, 10-3, MARCH—W-61-4. APRIL—W-68-5, 74-6. MAY — W-51-7, 96-8, 128-9, 159-10. JUNE—W-186-11, 171-12, 180-13, 190-14.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER for research (75%) and teaching (25%) in drainage, irrigation, soil and water conservation fields, in a state college in the Northwest. Instructor and junior, or assistant professor and assistant agricultural engineer rating. MSAE or equivalent with special interest and training in soil and water field preferred. BSAE with good scholastic record and experience may be acceptable. Limited opportunity for graduate work. Good health, initiative, dependability, resourcefulness. One month vacation. Retirement provisions. Salary open. O-23-732

AGRICULTURAL ENGINEER for teaching and research in soil and water field, in a state university in the South. Age 30-45. MSAE or equivalent for assistant professorship. BSAE for instructor rating. Farm background and field experience in irrigation or soil conservation desirable. Able to meet people and get along well with associates. Excellent opportunity to push the work to the limit. Considerable irrigation equipment already on hand. Opening to be filled as soon as possible. Salary $6,000-$7,000. O-237-733

NEW POSITIONS WANTED

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AGRICULTURAL ENGINEER for design, development, research and management in soil and water field with industry or public service, anywhere in USA or some other countries. Willing to travel. Married. Age 40. No disability. BS in civil and irrigation engineering, 1939, Colorado A and M College. Experience in field over 14 years in US and Central and South America. Salary open. W-192-16

AGRICULTURAL ENGINEER for sales or development work in farm structures or soil and water field with manufacturer, processor, consultant, or federal agency in Midwest. Married. No disability. Recently completed tour of extended active duty with US Air Force. BS in agricultural and civil engineering, specializing in farm structures. Farm background. Construction work experience during 3 summer vacations. Installations engineering work in Air Force 3 years. Available now. Salary open. W-238-17

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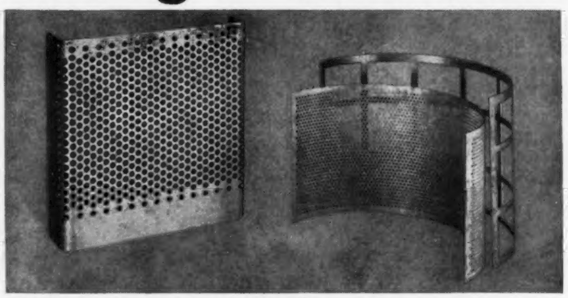

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